Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

Published by McGraw Publishing Company, Inc.

Volume 71 NEW YORK, SATURDAY, FEBRUARY 13, 1915 Number 7

Winter Concreting Improving

IT is too early yet for congratulation on the comparative freedom this winter from concrete disasters due to frozen and unset material. Possibly the remainder of the winter will upset the present good record. Undoubtedly, the mildness of the season and the very much reduced volume of work are contributing factors, but part of the improvement, at least, is due to the educational campaign waged persistently for years. Superintendents and foremen are becoming familiar with the dangers and, also, with the precautions that must be taken to avoid them. It is to be hoped that the caution so far exercised this winter may be continued, to the end that a high record for safe construction may be set.

Storm King Road

THERE is generally little of the spectacular in the building of a road. The very nature of the work robs it of the sensational possibilities of the steel skyscraper or the great bridge. Yet along the Hudson River at Storm King Mountain, the New York State Highway Department is building a road which has startling features. As described on page 192, the highway is, in reality, a shelf 400 ft. above the river, blasted from the face of a steep rocky cliff. To secure the topographical data it was necessary to lower the locating engineers 100 ft. by rope and to mark the route roughly, at inaccessible spots, by shooting, with a small cannon, cans of paint against the rock slope. When completed the highway will offer scenic beauties second to none in the East.

Another Tunneling Record

ON the Canadian Pacific's work at Rogers' Pass in British Columbia the breaking of the American hard rock tunneling record is becoming a regular monthly event. Not content with the remarkable progress of 817 ft. in November and 852 ft. in December the contractors, Foley Bros., Welch & Stewart, have established the mark of 932 ft. for the west pioneer heading during January. This is a performance which is likely to stand for some time. It indicates that the famous Alpine tunneling records, generally considered unattainable in American practice a few years ago, are by no means out of reach. The Canadian Pacific's bore was through slate and the dimensions of the heading were 7 ft. 6 in. x 10 ft. Drilling was done from a bar which was first placed for the top holes and then dropped for putting in the lifters. The work was described in detail in the Engineering Record of Dec. 19, page 659. Rapid tunneling is dependent upon men as well as methods and in no phase of construction work is organization more important. To A. C. Dennis, superintendent, and his staff credit is due for a remarkable demonstration of effective team-work.

A Hard Task Well Done

MR. CARLISLE'S resignation as commissioner of highways of New York should not be allowed to pass without a word of commendation for what he has accomplished. Coming into a department grossly mismanaged, with politicians and material men in the saddle, his task was not an enviable one. Firmly and persistently, without the publicity which might properly have been given his work, and would have resulted in better appreciation of it by the people of the State, he attacked the abuses in turn. New specifications were drawn, merit recognized, an efficient personnel developed, and, above all, the inspection placed on a stringent basis, guaranteeing that the State was receiving what it was paying for. A staff previously demoralized began to look up, to take pride in its accomplishments, to bend every energy to the securing of good work—and that in the face of inadequate pay. Only those who knew the department before Mr. Carlisle's advent can appreciate the magnitude of the change, can know what energies and ideals were required to develop the esprit de corps which now obtains. The Engineering Record on his selection regretted that the place did not fall to an engineer, but Mr. Carlisle's accomplishment justifies his appointment. Probably on the technical side he would be the first to acknowledge the assistance he received from General Rossell, consulting engineering to the department, and Mr. Ricker, first deputy. Mr. Carlisle's successor comes with a handicap. Not an engineer, nor with special experience in highway work, he must with other qualities make up for what Mr. Carlisle had learned. Though the curse of political expediency has required the change, the Engineering Record trusts that the department will not suffer—in fact, that, it may be the gainer.

Courting Incompetence

APROPOS of the comment on Commissioner Carlisle's resignation, it is pertinent to protest against a bill introduced in the New York Legislature which would reduce the number of division engineers in the highway department from nine to six and their salaries from $4000 to $3000 per annum. This would be a mistake, for on account of the responsibility devolving on those positions it is impossible to secure at the lower salary the ability necessary to fill them satisfactorily. Each division engineer handles about a million dollars worth of construction work each season, divided into a dozen or more contracts, while at the same time maintenance funds amounting to upwards of $800,000 may be expended under his direction. If the divisions are reduced in number the responsibility will be increased. Rather should the number be increased. Moreover, it should be remembered that the work is widely scattered, making its supervision all the more difficult. The legislators at Albany are largely lawyers, familiar, presumably, with the conduct of corporation affairs. If they will compare the rank and salary of men in corporations charged with equal responsibility, they will see the inadvisability of passing the bill in question. Not only is its passage inexpedient, but positively dangerous, for the interests of the State must suffer if incompetent men are at the helm. Appreciation of their oaths, if nothing else, should require adverse votes on a measure fraught with the danger of serious results for the State.

Appealing to the Public

TWO recent instances show that the constant dinning in the ears of engineers their duty to participate in public affairs has not been without fruit. Last week, in Chicago, the Western Society of Engineers adopted resolutions setting forth the ethical relations of the engineer to his client, such action having been prompted by acrimonious criticism of the engineers reporting on the Sanitary District's water-power development. The society did not take sides in the controversy, but accepted the opportunity of putting the ideals of the profession before the public. In Kansas City, the Engineers' Club, a few days later, passed resolutions and sent them to the Governor of Missouri, protesting against his appointment of a judge as surveyor of Jackson County, and requesting him to rescind his appointment and name a competent engineer instead. Both actions are calculated to set the public thinking as to the status of the engineering profession. The second, especially, will be heeded, for while a recommendation that an engineer be appointed to an executive position controlling engineering work will get a paragraph in the daily press, a protest directed to a Mayor or Governor classes with extraordinary procedures and receives space accordingly. The extent of the notice in the press, too, is probably an index of the relative impressions made upon the appointing power. As long as political reasons remain dominant in appointments, so long will it be desirable to show executives that political pressure, through the force of public opinion, will be brought to bear upon them. The expedient of protest, therefore, may well be made part of the machinery for bringing home to officials the need for engineers on technical commissions and as heads of technical departments.

A By-Product of the College Course

COMMENT has not been infrequent on the value to the engineer of the ability to think while on his feet. Its importance need not be argued, for even the student appreciates the advantage accruing to him who can persuade a board of directors, a legislative committee, a city council or a meeting of citizens. In a smaller way, rise to prominence is not infrequently due to influence in societies and associations which in themselves contribute little to one's success. The friends there made, through ability to speak, may be invaluable in other directions. The matter is mentioned here because students generally neglect until too late the opportunity afforded them in college to acquire facility in public speaking. It is impossible to include instruction in speaking in the engineering curriculum, but there are in every institution debating societies that open their doors as well to the students of the engineering college as to those in the liberal arts courses. Unfortunately, the allurements of the dancing club are generally greater than those of the literary society. The engineering club is sometimes looked to for the needed practice, but is not a satisfactory substitute. Its ideal does not lend itself well to the schedule which, in a debating society, gives frequent assignments, nor are its subjects such as stimulate debate. The engineering student, therefore, must look outside his own college for the training that he needs in public speaking. He must expect it to be a by-product of his college days.

Valuation Work Never-Ending

AN increase in value of 50 per cent in nine years on a financially embarrassed railroad to which little mileage has been added is indicated by Dean Cooley's valuation report on the Pere Marquette Railroad, abstracted on page 200. Dean Cooley states that perhaps the most obvious reason for the marked increase is the greater care used in making the latest appraisal. Although the road is by no means one of the largest, a good-sized organization spent six months on the work, taking field notes where paper records had formerly been relied upon. The results fill ten large boxes. By a careful study of the company's books it was found that a number of obscure but important items had not been accounted for at all in the previous appraisals. Although these appraisals were directed by Dean Cooley and although it can be taken for granted that, if his work was any less thorough than he thought necessary, it was because the State that employed him underrated the task and did not allow him sufficient time or money for the work, it is now apparent that the figures obtained fell considerably short of the true value. On the other hand, the value of the property has greatly increased, owing to numerous additions and betterments, and also to increased unit values. The report shows in striking manner the magnitude of the Government's undertaking of appraising all the railroads, the necessity for great care if a correct valuation at any one time is to be obtained, and the never-ending task of keeping the figures up to date after they have been obtained.

Licensing as a Defensive Measure

THE activity of the architects in pressing laws for registration has brought up the licensing or registration of engineers in a new aspect. In Illinois, particularly, the question is acute, for there engineers are estopped from designing buildings unless they are also architects, and licensed as such, or have their plans approved or sponsored by a licensed architect. This evidently is an undesirable condition, though it has been tolerated in Illinois for at least 15 years. Sentiment in the architectural profession plainly is in favor of licensing, as was evident at the last convention of the American Institute of Architects. The report of the committee recommending registration was not adopted, not because of lack of sentiment in its favor, but because it was believed to be a matter for the consideration of the local and not of the National body. It is to be expected, therefore, that the number of bills for licensing architects will increase. Apparently, engineers must be prepared to meet the situation.

There are four courses open: (1) To do nothing, (2) to persuade the architects to abandon licensing, (3) to urge the general licensing of engineers, (4) to urge restricted licensing, to extend only as far as need be as a defensive measure. The first, inaction, will not appeal to anyone with pride in his profession, or a proper interest in his means of livelihood.

The second, to change the views of the architects, seems hopeless. It is to be expected that they will resent interference by engineers, despite the fact that they are the aggressors in placing restrictions on the free practice of the engineering profession.

The third course, general licensing of engineers, is more extensive as a defensive measure than is necessary. One does not oppose an army corps to a single regiment.

The fourth course, licensing of structural engineers only, thus meeting the condition imposed by the registration of architects but not entailing hardship on practitioners in other branches, is an adequate and justifiable course. And this, evidently, is the conclusion reached by the legislative committee of the Western Society of Engineers. The final conclusion of the society itself has not yet been reached. Some members are advising inaction; others a campaign to persuade architects to recede from their position. If the latter held hope of success, the Engineering Record, too, would advocate that course, for registration, it believes, does not accomplish the primary object of the law—the insurance of the safety and health of the public. That object can be more surely attained by supervision of designs and of construction. Moreover, undesirable men cannot be kept out of the profession by licensing, so that this argument fails to justify the law.

First and last, engineers must insist on their rights. The best measure to conserve them should prevail, and in the case discussed the Engineering Record believes that restricted registration—confined to structural engineers—is the best.

College Men on Construction Work

COLLEGE graduates make good men on construction work if they can forget for a while that they ever went to college. This sounds discouraging to technical graduates who want to enter the construction field. They think it means throwing away the advantages of their education, and do not appreciate that their technical training will be a great help as soon as they have begun to learn three things that can only be hinted at in a college course. The first of these is the handling of men, as applied to all classes encountered on construction work, from chief engineer to laborer. The second is the handling of inanimate things and circumstances. The third is a full realization of his own ignorance, and that this field, like life, is so large that no one man can ever hope to know fully either the men or methods of even one branch of it. A man may follow this work for a lifetime, and at the end learn something new from a laborer.

This is the point at which the college man most often fails. It is very well to tell him he must learn men and things from a new viewpoint. He is apt to listen but still consider himself a favored pupil, who has a long start on other mortals and can attack the problem from a superior elevation, without actually soiling himself by too much personal contact. As a matter of fact, this idea is the college man's worst handicap, as everyone who has tried to break in a man burdened with this notion knows to his sorrow. In point of usefulness and teachability it puts him actually beneath the untrained men he looks down on. A college man who finds he cannot change this conception had better quit the field and try something else.

For the man who is willing to drop this feeling of superiority and go in with open mind and the idea of making friends of everybody on the "job," the first two lessons are easily learned, and his progress depends solely on his capacity and application. It is then that his technical education first begins to make him valuable.

Those who are training the college man in construction work should remember that the latter has spent a number of years where problems new to him have been analyzed under trained direction. Without regard to his class marks, if he be of good intelligence he must have absorbed some knowledge of the logical way of attacking a new subject. Therefore, it is fair to expect that he will learn faster than the untrained man, even though it may be some time before his actual engineering knowledge becomes of use.

A man's social success with his fellow students gives little indication of what he will do in the way of making friends with the American workman. There is a tendency to snobbishness in many of our large colleges. The man who has failed socially under such a system may have done so from a number of causes which have nothing to do with his ability to mix and get the other fellow's point of view. On the other hand, the man who succeeds in making himself popular under such a system has often lost his ability to take an interest in the affairs of anyone who has not been trained as he was.

As to drinking, it is not necessary or desirable in order to make friends with construction men. The present system in this country has trained most of them to drink, though many have broken away from it. All of them know, from first-hand object lessons, the consequences of excess, in the way of lost jobs, lost standing and lost earning capacity. They secretly look down on the young engineer who attempts to make himself popular in this way, and respect correspondingly the man who does not.

The college man who is not afraid to go out on a "job" and work with his hands in order to learn starts right. For such a man construction work offers a good field. Such a man is always in demand, for he proves more useful and more efficient in the long run than men who have had only practical construction experience.

Commercial Effort on a High Plane

CHANGES of heads of commercial organizations are seldom commented upon in these columns, not that they are not important but because this journal concerns itself with the use of engineering products, not with their methods of exploitation. The resignation, however, of Edward M. Hagar as president of the Universal Portland Cement Company, and the election of Benjamin F. Affleck as his successor, are events of much more than mere commercial importance, because of the influence these men have had on the correct use of cement—a matter directly within the province of the engineer. The company has built up a remarkable information and inspection bureau, which has served to educate those who otherwise would not have been reached by men of competent engineering knowledge. True, the impelling motive was commercial, but it was nevertheless a needed work, and one that, if unperformed, would have resulted in handicapping engineers because of the prejudice against cement that would have followed the inevitable failures. Furthermore, the work has always been so conducted as not to interfere with the work of the consulting engineer.

The organization was a leader, too, in the inspection of concrete road work; again, if you will, a commercial measure, but one with an undoubted bearing on the future of highway construction. Seeing that other road materials had failed or had been given a serious setback by being applied incorrectly, by incompetent contractors, and knowing further that the concrete road in incompetent hands was foredoomed, they put every road job using their cement under competent inspection. The expenditure has undoubtedly been repaid through the superior quality of the resulting roads and consequent prestige, but that does not detract from the fact that if the concrete road was to live its first successes were dependent on just such inspection.

As a further instance of the broad vision of the organization, there was held in Chicago last year the Conference on Concrete Road Building. The financing was assumed by the Universal company but the committee work was done by independent engineers and contractors, with some commercial men, too, but unhampered in any way by the commercial interests. The caliber of men who participated was a silent, and probably hitherto not mentioned, tribute to the officers of the company.

In resigning, Mr. Hagar, fortunately, leaves a successor fully in accord with the policies discussed. To both the Engineering Record extends its best wishes.

The Preparatory School and After

A STRIKING analysis of the work of the students at the Massachusetts Institute of Technology in relation to their preparation and student activities has just been made by the registrar of that institution. There has of late been comment in these columns regarding the importance of a broad training in professional studies even up to a comparatively late stage, and the danger of too early specialization. The record of the Massachusetts Institute of Technology shows, as it has ever since the subject has been studied, that the students who come from the technical high schools are less efficient as a class than those trained in the ordinary high schools, where there is little pretence of specialization. The difference appears in the first year's work and persists all through the course.

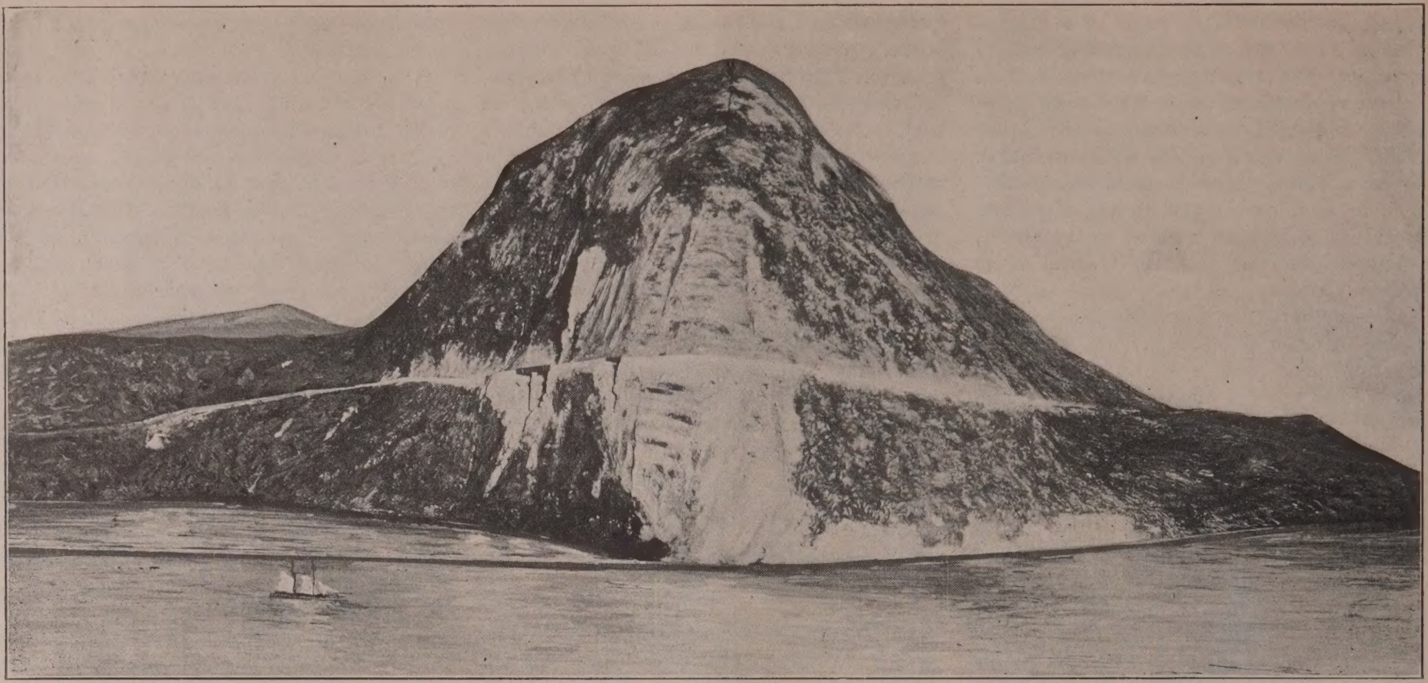
One must not jump hastily at conclusions in this matter, and lay the whole blame on specialization in the high school, because it is undoubtedly the fact that the technical high schools probably draw a somewhat less efficient body of boys in the matter of serious scholarship. A great many boys who do not like the disciplinary work of the ordinary high school and have a hazy idea that they want "something practical" turn at once to the technical high school in the hope of an easier path to applied knowledge. If in any case the path is really easier it is so because of inefficiency, so that the graduates of a technical high school are likely to include a considerable number of boys who have not the spirit of buckling down to work for work's sake, which is necessary for their future success. However this psychological matter may enter the question, experience shows, not only in the Massachusetts Institute of Technology but in other institutions, that the boys who enter with the thin veneer of applied science which can be given in the time available in a technical high school, generally get it rubbed off very quickly, and succeed only by virtue of the real worth of the underlying material. The same principle has been found to hold as regards post-graduate work, in comparing men taking it with too little general foundation, uncompensated by the small amount of specialized knowledge which they have acquired.

It is also found at Technology that men from distant high schools do on the whole rather better than those from the immediate vicinity of Boston, a fact partly ascribable to a certain amount of natural selection in the material drawn from a distance, but also perhaps somewhat chargeable to the extent to which schools of Eastern Massachusetts have gone into specialized work of somewhat dubious disciplinary value. Further, the students coming from the private schools to Technology average very materially worse than those who come from the public schools. This difference, too, is one into which several factors undoubtedly enenter.

In the first place private schools, in a territory which is supplied with fairly good public schools, are generally social rather than educational institutions, much as they may dislike to face the fact. The boy who drives to school in his own car, or with his private chauffeur, to foregather with other boys of the same class, and who considers athletics and social functions as the most important part of his responsibilities, is not likely, assuming equal mental capacity, to put as much hard work into his school life as the chap who has a keen realization that he must stand on his own legs in making his way in the world. Another phase of the same matter is that the very tendency which draws together boys, so to speak, of the leisure class, creates a strong temptation in the managers of the school to temper the wind to the shorn lamb as much as circumstances permit, and to shove the aforesaid lamb into the higher institution with the minimum of effort. Schools, like individuals, often follow the path of least resistance.

Finally, taking the student as he is, what is the effect of the non-scholastic activities of the college upon his intellectual growth? From the showing set forth by the registrar most of the activities have on the whole a rather depressing effect, the chief exceptions being the few lines which presuppose in the student exceptionally keen intellectual powers. It should here be said that athletics in the Massachusetts Institute of Technology is so much less prominent than in most other institutions that comparisons in this particular are hardly fair. The club life of the fraternities here, as elsewhere, is associated with scholastic results a little below the average, not enough below, however, to be particularly significant, especially when one realizes that some of the fraternities have considerably more than their share of high stand men. The effect of student activities and fraternities could undoubtedly be studied with far greater advantage in institutions where the normal pressure of work is less than at the Massachusetts Institute of Technology.

The facts already brought out regarding the relation of the preparatory school to the success of the student in college, however, are of the first importance, and should be thoroughly studied in order to evaluate the various factors, psychological, social, and intellectual, which make up the final result.



THE STORM KING ROAD ALONG THE HUDSON IS THE NEW YORK STATE HIGHWAY DEPARTMENT'S MOST SPECTACULAR WORK

Storm King Road a Shelf Blasted in Mountainside 400 Feet Above the Hudson

On Picturesque River Road New York State Engineers Took Topography While Suspended From 100-Foot Rope

GIRDLING the rugged slopes of Storm King Mountain 400 ft. above the Hudson River, along a route so difficult of access that engineers were forced to collect topographical data while swinging in space at the end of a 100-ft. rope, the new 1.27-mi. New York State highway for which bids were received in December will open to traffic the most picturesque section of the Hudson valley, save a 15-mi. detour inland along existing routes, and involve the most daring piece of highway construction in the State. From the face of the mighty cliff 35,000 cu. yd. of ledge rock must be removed by quarrying methods while traffic is maintained on the West Shore Railroad below, and the contract includes a $10,000 item for a traveling crane and car which will be in readiness at all times to remove from the tracks any chunks of rock which might fall from above and wreck a train. In marking out the route the reconnoissance party was forced, at certain precipitous places, to shoot cans of paint against the face of the cliff from a small cannon borrowed from the army officers at West Point. The engineers' estimated cost of the roadway is $229,000, exclusive of land damages, and the contract requires its completion in 200 working days.

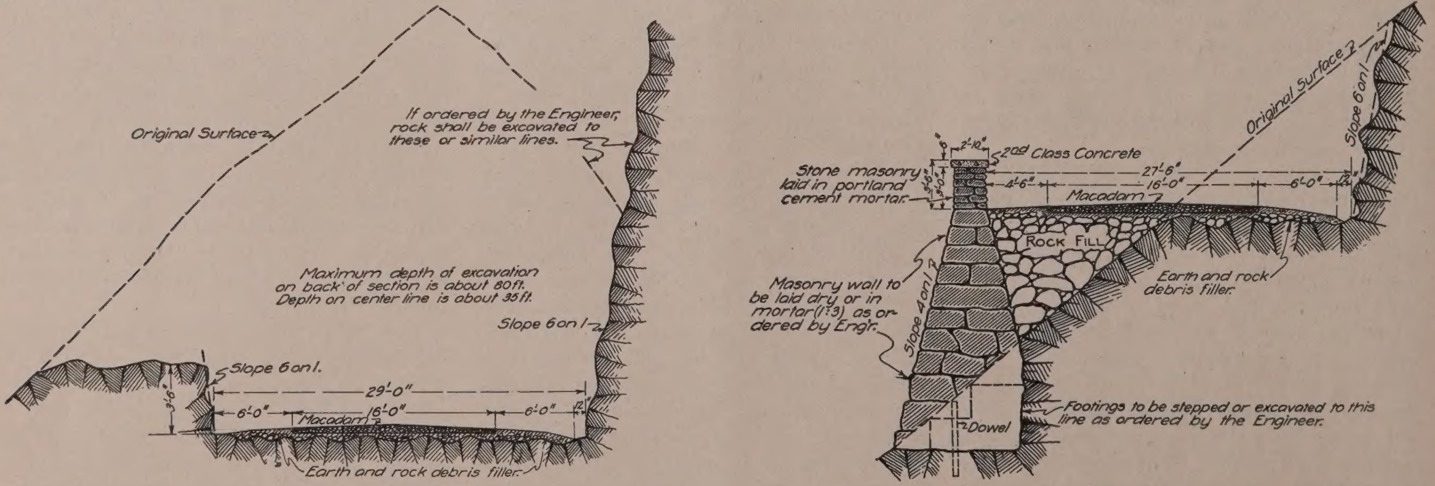
The contract starts at Bay View Avenue, Cornwall, 190 ft. above the river, running to an apex 200 ft. higher up, and then descends to an elevation of 213 ft. at its southerly end. Its grades change from 6.3 per cent for 250 ft. at the start, shifting between 3.2 and 5.7 until the summit is reached, about ¾ mi. farther on. There are no unusual cuts or fills on this ascending slope.

BRIDGES ON ROUTE

Leaving the summit, the road descends a distance of ¼ mi. on a 7-per cent grade. On this section the contractor will be obliged to construct a 187.6-ft. steel truss bridge and a 72.9-ft. reinforced concrete structure. Approximately 131 tons of metal will be required for this work. The larger bridge is of steel deck Warren truss construction, with two equal spans, supported in the center by a concrete pier. Including abutments, it will require 218,000 lb. of steel, 12,000 lb. of reinforcement bars, and 7000 lb. of expanded metal. Steel cross-girders encased in concrete, stretching from a large steel plate-girder on the outside of the roadway to solid rock anchorages underneath the road constitute the smaller bridge. Its erection will mean the use of 22,800 lb. of steel, 1200 lb. of corrugated steel and 2000 lb. of expanded metal. Shop drawings on structural work are required to be prepared by the contractor.

EIGHTY-FOOT VERTICAL ROCK CUT

Midway between the two structures the cut varies from 35 ft. of ledge rock at the center of the highway to a depth of 83 ft. on the extreme inside. The largest cut shows 1573 sq. ft., while the maximum fill is 7590 sq. ft., consisting of 78 ft. at center, 89 ft. from grade to lowest point, and 182 ft. of horizontal width at base. This is


Original Surface
If ordered by the Engineer, rock shall be excavated to these or similar lines.
Maximum depth of excavation on back of section is about 80 ft. Depth on center line is about 35 ft.
Slope 6 on 1
Slope 6 on 1.
29'-0"
6'-0"
16'-0"
6'-0"
Macadam
3'-6"
Earth and rock debris filler
Stone masonry laid in portland cement mortar
2'-10"
2nd Class Concrete
27'-6"
4'-6"
16'-0"
6'-0"
Macadam
Original Surface
Slope 6 on 1
Rock Fill
Earth and rock debris filler
Masonry wall to be laid dry or in mortar (1:3) as ordered by Engr.
Slope 4 on 1
Dowel
Footings to be stepped or excavated to this line as ordered by the Engineer.

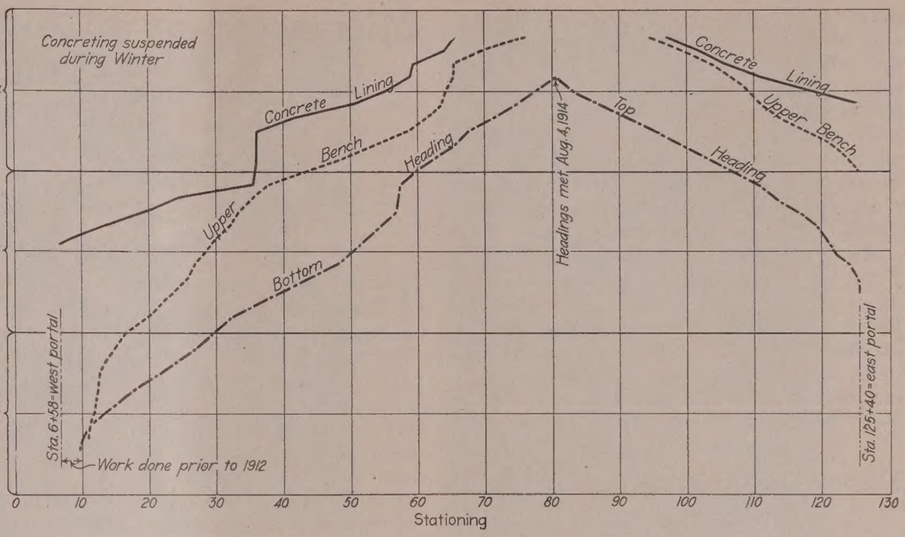
FROM THE FACE OF THE CLIFF 35,000 CUBIC YARDS OF ROCK MUST BE REMOVED BY QUARRYING METHODS made necessary by the gouging out of the rock to form a shelf for the roadway, which work commences on the descending grade and continues for approximately one-quarter of a mile. Then the excavation changes from ledge rock to boulder cut.

Masonry walls will be built on a slope of 4 to 1, the lower side resting on the step foundation in the rock. In building the masonry, dry or laid in mortar, it is required that at least 75 per cent shall be one-man stone, or larger, and all holes shall be filled and all stones wedged in place with suitable spalls. At least 25 per cent of the face stone shall be headers 3 ft. in length and all shall be at least twice as deep as they are thick.

The survey for the Storm King road, which was completed early last spring under the direction of George A. Ricker, first deputy commissioner, and in immediate charge of Mark W. Nelson, first assistant engineer of the New York State Highway Department, presented almost insurmountable obstacles.

Bottom Heading Successful at Snoqualmie Tunnel

Both Top and Bottom Methods Were Used on New 2-Mile Bore of Chicago, Milwaukee & St. Paul Railway near Seattle



PROGRESS OF BOTTOM HEADING, UPPER BENCH AND CONCRETE LINING

BOTH the top-heading and the bottom-heading methods were used in driving the Snoqualmie tunnel of the Chicago, Milwaukee & St. Paul Railway 40 mi. east of Seattle. The former method was used at the east end and the latter at the west. Although the top heading showed a slight advantage in average progress, the removal of the bench was more readily accomplished with the bottom heading.

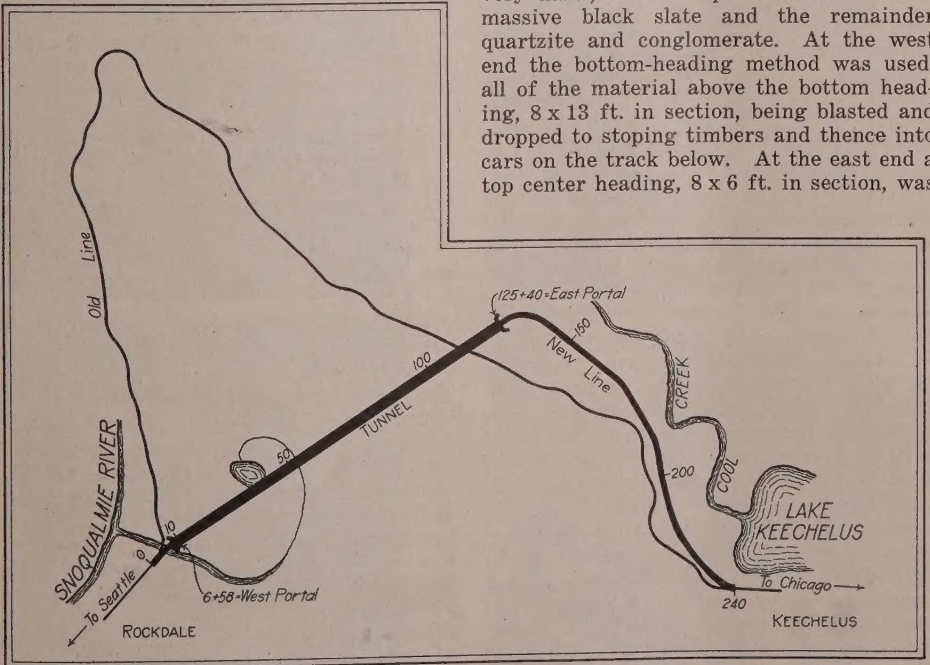
When the Chicago, Milwaukee & Puget Sound Railway was built through the Cascade Mountains it was found expedient to locate the line temporarily over Snoqualmie Pass at an elevation of 4000 ft., although this involved grades in excess of the desired maximum. As soon as the line was in service, however, the need of a tunnel was at once felt, and was emphasized by the cost of operation over the heavy grades and the expense of keeping open a section of the line subject to snow drifts as much as 40 ft. deep.

Work on the tunnel began at Rockdale late in 1911 on the general plan of construction shown in the accompanying map, but was not pushed rapidly until after the very severe winter of 1912-13. Since that time four 6-hr. shifts have been kept in each heading, and the total force at the tunnel has averaged more than 300 men. Steady progress was made up to the time headings met on Aug. 4, 1914.

The tunnel is a single-track bore 11,902 ft. long, having one portal on the western slope of the range at Rockdale and the other near Keechelus. The saving in distance will be about 3½ mi., and 1239 deg. of curvature will be eliminated. The tunnel is being built on an ascending eastbound grade of 0.4 per cent to a point 2000 ft. west of the east end, whence eastbound traffic will descend a 0.1 per cent grade to the portal.

DRILLING METHODS

All of the material encountered during the driving was rock, varying from soft to very hard; about 75 per cent of it was a massive black slate and the remainder quartzite and conglomerate. At the west end the bottom-heading method was used, all of the material above the bottom heading, 8 x 13 ft. in section, being blasted and dropped to stoping timbers and thence into cars on the track below. At the east end a top center heading, 8 x 6 ft. in section, was driven first and muck was loaded into cars on the high-line tracks. At the west end gasoline motors and steam dinkies handled the muck in 1-yd. and 1½-yd. cars, while at the east end electric motors and steam dinkies were used in the interior and exterior workings respectively. The engineers report that the bottom-heading method proved much more satisfactory in many ways. The average progress with the bottom-heading method was 9.5 ft. per day as against 10 ft. per day with the top-heading system; the bottom heading could not be driven faster than the top, but the removal of the bench was more readily accomplished.



THE NEW LINE SAVES 3½ MILES AND 1239 DEGREES OF CURVATURE

Each heading was drilled by four Ingersoll-Rand piston drills mounted on a cross bar, and from sixteen to twenty-five holes were placed for each round. From 2 to 8 lb. of 60-per cent gelatine dynamite were used per round, according to the class of rock encountered, and all blasting was done with fuse and caps. Ventilating fans housed at the portals provided ventilation by drawing out powder fumes through a 20-in. galvanized-iron pipe that terminated at the end of the completed bench. In addition to this fresh air was forced into the heading through a 10-in. galvanized-iron pipe line, canvas hose being substituted for the 60 ft. next to the heading. As the distance between portal and heading was increased, the pressure in the air lines was maintained by adding motor-driven booster fans as required.

TUNNEL LINING AND APPROACH CUTS

The tunnel is to be lined with concrete for its entire length, and concreting is being carried on simultaneously with the driving. All concrete is mixed on the outside and is hauled in on the high-line tracks, about 16 ft. above grade, so that there has been no interference with materials going into the tunnel or with muck coming out. Concrete gutters 10 x 12 in. in section will be provided on each side, and 90-lb. rails on creosoted ties and crushed rock ballast are to be used.

Signal and telegraph wires will be carried through two 3-in. fiber tubes embedded in the north wall, to which access can be had at intervals of 300 ft., where refuge niches 2 ft. deep are placed. These niches will be provided with wooden terminal boxes, and these will be used when the cables are to be drawn through or repaired.

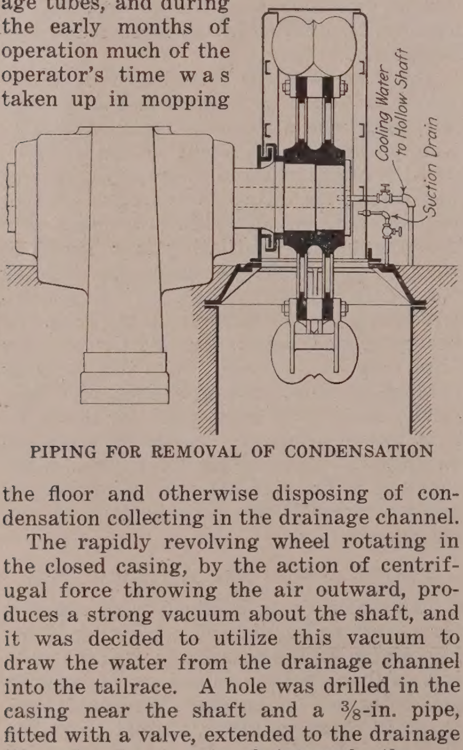
Two miles of grading was necessary in

building the tunnel approach on the east end, and new yards were laid out at Rockdale on the west, including a 105-ft. turntable. When the tunnel is in service all westbound trains will be hauled from a point east of the tunnel to tidewater by one engine. Eastbound trains will require helper service from Cedar Falls to Rockdale, a distance of about 19 mi., with a maximum grade of 1.74 per cent, compensated.

All of the work, with the exception of the 2 mi. of approach grading, has been done by company forces under the personal supervision of J. I. Horrocks. E. O. Reeder, at Seattle, Wash., is assistant chief engineer, and C. F. Loweth, Chicago, is chief engineer of the Chicago, Milwaukee & St. Paul Railway.

Disposal of Condensation on Waterwheel Housings

Where waterwheel units exposing large surface areas of casing to the air are operated in hydroelectric power houses, the water of condensation is a source of trouble to the operating engineer. This is usually collected in a channel cast about the periphery of the sub-base, and drained to the tailrace. On the 20,000-hp Pelton-Doble units installed at the drum power house of the Pacific Gas & Electric Company several hundred square feet of surface are exposed to the heated air of the power house, and the resulting condensation is copious. Operating conditions made it inadvisable to utilize the customary drainage tubes, and during the early months of operation much of the operator's time was taken up in mopping the floor and otherwise disposing of condensation collecting in the drainage channel.



PIPING FOR REMOVAL OF CONDENSATION

The rapidly revolving wheel rotating in the closed casing, by the action of centrifugal force throwing the air outward, produces a strong vacuum about the shaft, and it was decided to utilize this vacuum to draw the water from the drainage channel into the tailrace. A hole was drilled in the casing near the shaft and a 3/8-in. pipe, fitted with a valve, extended to the drainage channel. At occasional intervals the operator opens this valve, and the condensation collected in the drainage channel is quickly removed.

A Highway for Motor Trucks, which is to be constructed between Los Angeles and the harbor, a distance of 24 mi., is to have a width of 35 to 40 ft. and a concrete base of sufficient thickness to withstand the wear of the heaviest motor traffic. The cost will be approximately $30,000 per mile, or three times the cost for the ordinary paved highway in this district.

Microscope as an Aid in Proportioning Concrete for Strength

Third in a Series of Six Articles—Demonstrating the Influence on Strength of the Ratio of Cement to Aggregate "Burden"

By NATHAN C. JOHNSON
Engineer of Tests, Raymond Concrete Pile Company, New York

Copyright 1915 by Nathan C. Johnson

In the preceding articles of this series, there have been discussed certain defects in commercial concretes, together with some weaknesses, primary and secondary, directly attributable to them. In adducing proofs for these discussions, the microscope, in conjunction with the photographic camera, has been the principal reliance. The same means will be employed in the investigations in this present paper, but the manner of their utilization and the character of the problems attacked will be somewhat different.

Microscope a Handy Tool

In order that these variations of procedure may be understood, it may be well to emphasize here that the microscope is not so much a delicate, scientific instrument as it is a very handy tool that does not necessarily required a prolonged training for its use. There is no mystery or complication about a field glass. That is an every-day affair, used to magnify a distant object until it becomes sensible to our limited range of vision. Nor is there any mystery about the ordinary magnifying glass, which shows an enlarged image of a small object near at hand. Yet, if an arrangement of lenses similar to this field glass or this magnifying glass is so mounted as to be mechanically convenient, it is invested with the dignity that goes with the name of "microscope"; and, inferentially, its use is prohibited by any save grey-haired scientists. On the contrary, the microscope is a most convenient tool, adapted to a wide range of uses. Nor is it necessarily complex, or delicate, or costly. Even an inexpensive instrument can give very excellent results, and will open the door to a field undreamed of by those who know matter only in the gross.

Micro-photography—or, to use the proper though less convenient name, photo-micrography—is merely the using of photography to render permanent the otherwise transient images seen through the microscope. Essentially, it is nothing more than a camera-bellows fitted to the eye end of the microscope; and its employment should be no more complex than the use of a hand camera. If the photo-micrographs used to illustrate these discussions are considered as ordinary pictures taken by a magnifying lens in an ordinary camera, it may aid in an understanding and a proper valuation of them.

In cement investigations, this conception is nearer the truth than may be imagined, for it is often of the greatest service to take direct photographs of the concretes at from one-half to four powers, without the interposition of a microscope. By this procedure, the character of gross sections and the interrelation of large aggregate may be studied, while, by supplementing these photographs with others taken at higher powers through the microscope, the entire range from gross to micro-structure is covered, so that true values are established by comparison and erroneous conclusions prevented. This procedure will be followed in obtaining evidence for the discussions of this paper.

Having been chiefly concerned in previous articles with certain defects of concrete, and having learned of some of the consequent ills that concrete is heir to, it becomes of prime importance to inquire as to how those defects may be either remedied or wholly eliminated, so that future construction may be more reliable.

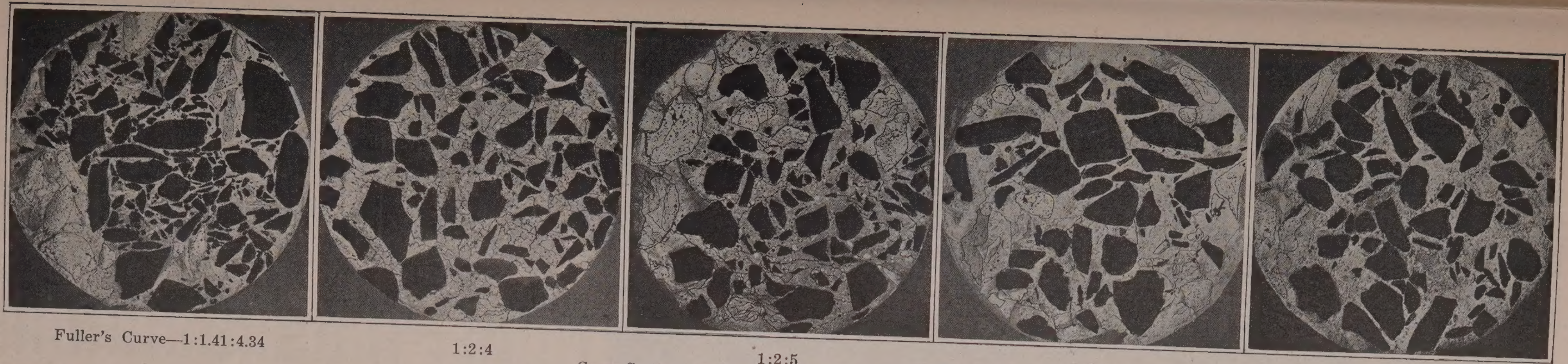
In all probability, those concretes which have so far been examined—all of them commercial or field-mixed concretes, as distinguished from laboratory-mixed concretes—had proportions of cement, sand and stone such as 1:2:4, 1:2½:5, 1:3:6 or 1:4:8, since these are "standard" in field work. Yet, although proportioned and mixed in accordance with accepted practice, the concretes seem to be decidedly faulty.

It would be most interesting to know why this is so. There certainly is no denying the fact. Should the cement be blamed? That, at least, is current practice. Were the proportions wrong? Was there loam in the sand—whatever of good or evil that may really mean? Was the mixer in poor condition? Speculation is easy, but unfruitful of results, unless it should lead to an inquiry as to what the "old reliable," "practical" 1:2:4 or 1:3:6 or any of these arbitrary mixes really are. It is a heretical question, but as it is one of prime importance it may be well to answer it by running the gamut of these proportions in laboratory mixes, testing them in the usual ways, then sectioning and polishing both large and small specimens to determine the internal behavior and arrangements by means of the photographic camera and the microscope.

Photo-Micrographs of Different Mixes

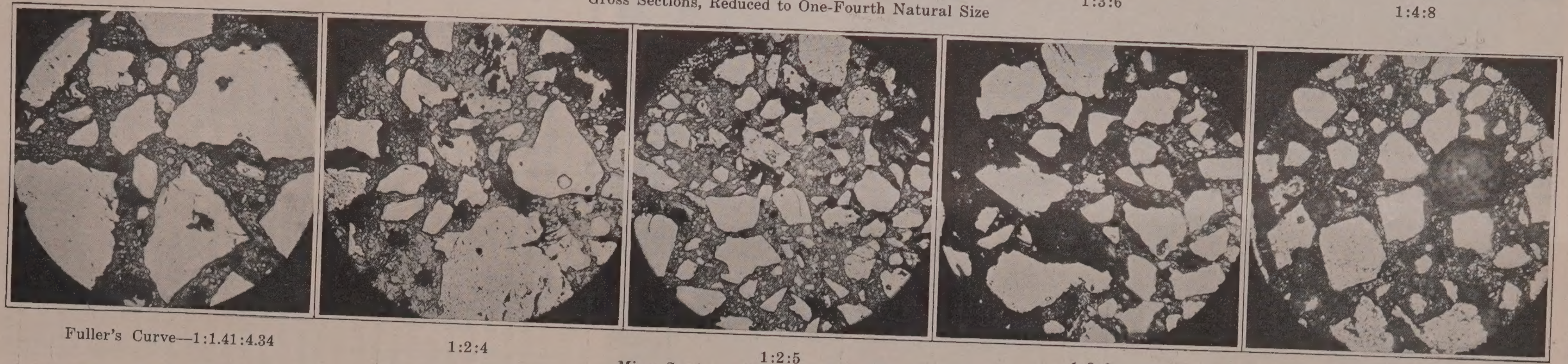
In the top row of Fig. 14 are shown one-fourth-power photographs (taken by direct photography) of five laboratory test cylinders, each 8 in. in diameter by 16 in. long, all made with the same aggregate. Four of these are stereotyped mixes, proportioned 1:2:4, 1:2:5, 1:3:6 and 1:4:8. The fifth is an unrecognized friend, so far as most field work is concerned—a concrete made with the same aggregate as was used in the others, but graded to conform to Fuller's curve of maximum density. (Wm. B. Fuller in "Concrete, Plain and Reinforced," by Taylor and Thompson, p. 183.) Its proportions are 1:1.41:4.34.

Obviously the photographs in the top row have been touched up. The actual photographs of the sections were rather small. These were enlarged 1½ times full size, to a diameter of 12 in. To bring out the various features, red and black drawing inks were resorted to—the black to bring out the stones and outline the boundaries of those dislodged in grinding, and the red to make prominent voids and cracks. These retouched enlargements were then re-photographed in reduced size, so as to render the gross structure of the concretes more readily comparable with the micro-photographs of their several mortars, which latter are placed below. In this way, the internal ar-



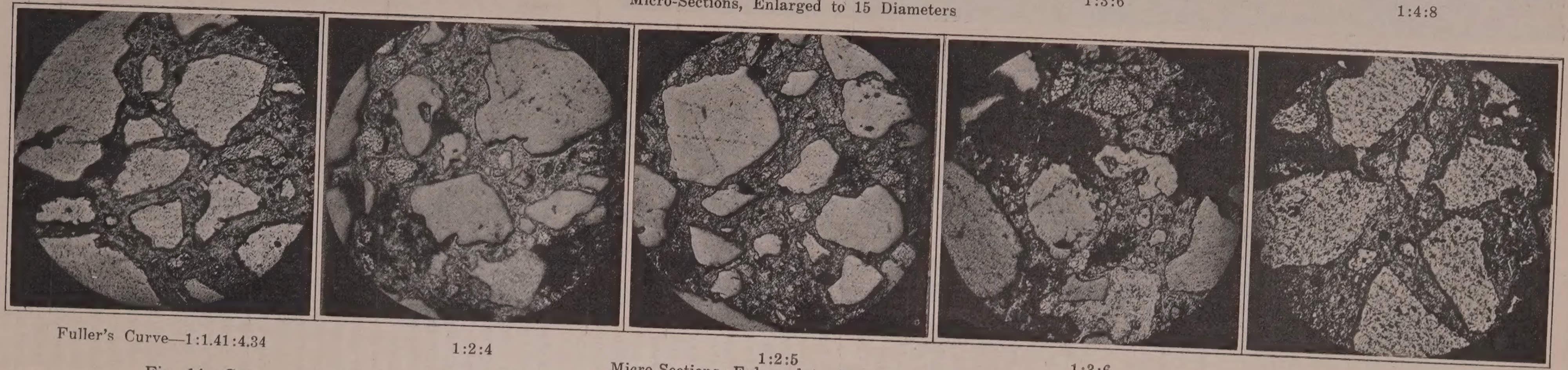
Fuller's Curve—1:1.41:4.34 1:2:4 1:2:5 1:3:6 1:4:8

Gross Sections, Reduced to One-Fourth Natural Size



Fuller's Curve—1:1.41:4.34 1:2:4 1:2:5 1:3:6 1:4:8

Micro-Sections, Enlarged to 15 Diameters



Fuller's Curve—1:1.41:4.34 1:2:4 1:2:5 1:3:6 1:4:8

Micro-Sections, Enlarged to 40 Diameters

Fig. 14—Gross and Micro-Sections of Different Mixtures, to Show Character of Matrix as Ratio of Cement to Aggregate "Burden" Is Changed

rangements of these mixes become visible, even to the smallest particles; and by these means the causes of vexatious faults may be determined. When causes are known, remedies usually suggest themselves.

With the exceptions of the Fuller's curve and the 1:4:8 concrete, the cylinders that were sectioned and polished had been tested in compression to the yield point. For convenience with the former and because of the weak nature of the latter, the sectioned cylinders of these two were not crushed, compressive strengths being determined on like specimens made at the same time.

With these two exceptions, therefore, it is possible to see how the several concretes bore their load; and how and at what point they failed—a sort of concrete character analysis. The areas covered by stones dislodged in grinding were not blacked in, because the matrix in which the stones were embedded reveals several important matters which it was desired not to obscure.

What the Photos Show

These photographs will repay a very careful study. First of all should be noted the very great number of pores and voids, large and small, not only between the stones, but *especially in those places where stones were bedded.* This is a direct confirmation in gross sections of the isolation of small aggregate shown by photo-micrographs in Article 1. The bridging of air voids by aggregate is not a theory. It is an actual, provoking fact, and will remain so *unless means are found to prevent adhesion of air to aggregate.* This question will be touched upon more fully in a subsequent article.

The next feature to which attention is directed is that all of the shear planes due to crushing *run from pore to pore,* whether in the matrix visible between the stones, or in that portion which would be covered had all the aggregate remained in place. This is but one more bit of evidence as to the pernicious effect of air entrained in concrete, as well as additional confirmation of the reasons previously adduced for the necessity of using superior aggregate to produce a very inferior product.

Strength of These Mixes

Remembering that the greater the proportion of stone in a concrete, the greater its strength and density, it is interesting next to estimate the *strength* of these several mixes, from the appearance of their sections.

Obviously the first of the series, the concrete proportioned according to Fuller's curve, or the 1:1.41:4.34, shows the greatest proportion of stone. It also is the strongest by test, by a few pounds, 2420 lb. per square inch at 14 days. (This age is too early to give strictly representative crushing strengths.)

Next in order of stone content is 1:2:5, with a strength of 2280 lb. per square inch, as would be expected from the ratio of stone to sand. The others of the series hold this ratio constant, so that their surfaces show approximately equal stone areas.

Ratio of Cement to Aggregate "Burden"

However, the concretes grow progressively weak. If stone content alone were the determining factor, this would not prove true, but the question of ratio of cement to sand plus stone now demands consideration. In this the photo-micrographs of the several mortars, shown in the other two rows of Fig. 14, are of considerable assistance.

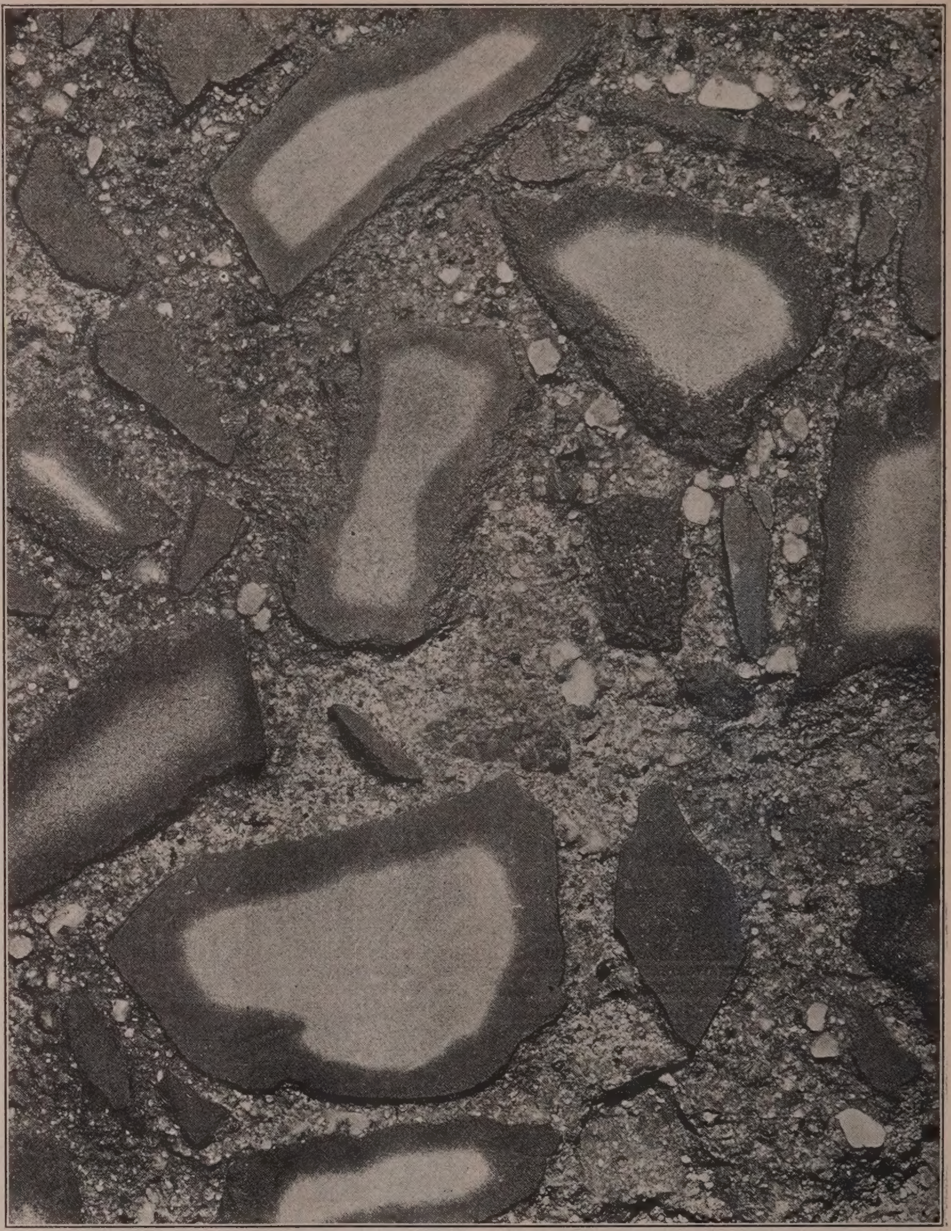


FIG. 15—WEAK CHARACTER OF MATRIX OF 1:4:8 MIX; TWICE NATURAL SIZE

In any concrete, or in any mortar, the function of the cement is not only to coat the sand and the stone with an adhesive film, but also to fill all voids between the sand particles and the pieces of stone. If the ratio of either or of both of these materials to the cement is increased, or decreased, there is a corresponding change in the burden on the cement, both as a void filler and as a coverer of surfaces.

Bearing this in mind, it is no wonder that concretes of different proportions have varying strengths. Since the 1:1.41:4.34 concrete has proved to be the strongest, it may be taken as a basis of comparison. If surfaces of aggregate are assumed as proportional to volumes, the ratio of cement to surface of sand and stone in this concrete is 1:5.75. In the 1:2:5 concrete, it is 1:7. In the 1:2:4 concrete, it is 1:6; in the 1:3:6 concrete, it is 1:9, and in the 1:4:8 concrete, it is 1:12. The same ratios should hold approximately true for the relation of cement to voids. These ratios, together with test strengths of the corresponding specimens, appear in the table at the bottom of the preceding column.

Ratio of Strength to Burden Imposed by Aggregate

Mixture	Ratio of "burden"	Strength lb. per sq. in.
Fuller's	1:5.75	2,420
1:2:4	1:6	2,260
1:2:5	1:7	2,280
1:3:6	1:9	1,012
1:4:8	1:12	590

Matrix Structure

The photo-micrographs of the several mortars at both 15 and 40 powers confirm what has before been said. The 1:1.41 mortar of the Fuller's-curve concrete shows plenty of cement to coat over and to fill between the sand grains. The 1:2 mortars of the 1:2:4 and the 1:2:5 concretes show the same feature, with possibly something in favor of the Fuller's-curve concrete in the matter of filling voids, due possibly to a greater surface-covering demand on the cement, with resultant thinning of matrix layer.

The 1:3 mortar of the 1:3:6 concrete shows a weak, faulty structure, full of holes and with the voids between the sand grains only partially filled with cement, as is evidenced by the dark spaces in the photographs. The 1:4 mortar of the 1:4:8 concrete exhibits the same character, but to a more marked degree, and with a notably less dispersion of the sand grains relative to one another, due probably to the smaller quantity of intrusive, unhydrated cement. And to confirm our reasoning and our findings thus far, Fig. 15 shows a portion of the 1:4:8 concrete surface, enlarged to twice natural size, which makes even more evident the weak character of this matrix, with the sand grains loose and ready to fall out. If careless mixing were to fill such a concrete full of air holes, so as still further to weaken it, its fitness for bearing any load beyond its own weight might properly be called in question. This, however, holds true only for concrete made from this particular aggregate. A concrete of the same proportions with different aggregate might be very excellent.

IMPROPER "BURDEN" ON CEMENT

In view of the foregoing, it is evident that many of the common defects of concrete are due to the imposing of an improper burden on the cement by poor proportioning. Further, arbitrary proportions, or test proportions, that may be suitable for the use of one sand, or for a certain grade of crushed stone, or of bank gravel, may be quite the reverse for a different sand and the same stone, or for the same sand and a different stone, or for a change in both sand and stone. *Each material has surfaces and voids peculiar to itself* and the quantity of cement must be sufficient to coat these surfaces and to fill these voids, with as little in excess as possible, else the matrix layer will be either insufficient in quantity or else unduly thick, with the production, in either case, of poor concrete. Arbitrary properties are a shibboleth. Sooner or later they will have to be discarded in high-class concrete work; and the sooner this is done the better for the industry.

But poor proportioning of aggregates is not alone responsible for the production of poor concrete. In a search for causes as important as that being undertaken, "snap-judgments" are to be carefully avoided. In the next paper of this series certain other factors in the problem will be studied, with special reference to the light thrown upon them by microscopic studies.

SUMMARY

Summarizing the preceding discussion, it should be noted:

1. That the microscope as applied to the study of concrete is not so much a complicated, scientific instrument as a simple, handy tool, capable of rendering visible phenomena and objects beyond the range of unaided vision.

2. That the minute phenomena observed in micsroscopic study are repeated in the gross; and that gross sections of actual concretes show the characteristic air voids and separation of aggregates that were observed in the mortars previously studied.

3. That the planes of failure in a crushed concrete run from air void to air void, confirming previous reasoning in regard to the weakening effects of such voids, and the necessity of employing aggregate of high strength to bridge these points of weakness.

4. That the prevalence of air voids and fissures in the mortar of gross sections similar in character to the voids and fissures isolating sand grains in the micro-sections previously taken, is even greater at surfaces of contact with the large aggregate than in other portions of the matrix.

5. That a concrete having surfaces of aggregate in proper proportion to the cement, considered both as a void filler and as an adhesive, is the best concrete, both in strength and density.

6. That arbitrary proportions mean little, that proper proportions for certain aggregates do not hold for unlike materials, and that concretes arbitrarily proportioned are usually inferior in density and strength.

7. That a prime factor, though not the only factor, in producing good concrete is *proper proportioning*, and that without this the best materials are rendered valueless.

The next article in this series will be published in the issue of Feb. 20.

Kinks in Road Construction

Short Cuts for the Road Contractor Suggested by C. D. Franks in a Paper Presented Before the Indiana Engineering Society

When no level is at hand and the grade of a stake must be transferred from one side of a roadway to the other a hose filled with water solves the problem. Hold one end level with the top of the stake of known elevation and set the stake on the opposite side at the elevation of the water at that end. This and other kinks in road construction were given by C. D. Franks in a paper presented recently to the Indiana Engineering Society.

REMEDIES FOR PIPE TROUBLES

It frequently becomes necessary to take a section of pipe from the pipe line to remove an obstruction or for some other purpose. For this reason unions which will allow one pipe to turn without turning the one next to it should be placed at distances not to exceed 500 ft. apart. Otherwise, the entire pipe line must be turned to remove one section, necessitating the use of unreasonable force. Tees and taps should be placed in the line not farther apart than twice the length of hose which will be used to connect the water pipe with the mixer. This hose should be at least 1 in. in size to reduce friction and preferably should be short for the same reason, so that it will be well to space the tees and taps not farther than 200 ft. apart.

Some sort of relief valve must be used in the pipe line so as to prevent the breaking of the pipe or the blowing out of the cylinder head in the pump when it is running and no water is being used. Spring relief valves have been used with success, but a simple arrangement may be used to take their place. At one of the tees previously placed in the pipe line near the mixer, insert one or more lengths of pipe vertically upward. The top end of this pipe is to be left open. This standpipe should be moved frequently so as always to be close to the mixer.

Expansion joints of some kind must be placed in the pipe, preferably at distances not to exceed 2000 ft. The copper expansion joint is a standard fitting and is often used for this purpose, or a satisfactory expansion joint may be formed by three sets of fittings consisting of two elbows and a nipple, so placed as to make a "V" in the pipe line. Another satisfactory method is to offset the end of one pipe from the other slightly—say a distance of 3 in. These two ends should then be connected with a rubber hose. Connections of this hose with the pipe must be tightly made in order to prevent leaks and the hose should be of a size at least equal to that of the pipe to reduce friction, which naturally will be greater where the water is forced through any bend. Sufficient hose should be used to provide for a movement in the pipe of 6 in.

BOILER PLATE RUNWAYS

It is customary, to prevent cutting up the subgrade, to lay planks upon it for wheelbarrow runways. These planks are heavy, they become watersoaked, and their thickness makes wheeling onto them a difficult matter. One contractor was able to procure a large amount of scrap boiler plate which was ¼ to ⅜ in. in thickness. This made excellent runways for the wheelbarrow, reduced the labor of wheeling, and the contractor who used this scheme thought that it saved him considerable money.

Of all the tools used on concrete roads, probably none should be of more interest than the split float, because of the fact that in some cases roads and pavements are built without protection at expansion joints. When expansion joints are built without protection plates, it is always advisable to allow the expansion material, usually tarred felt, to extend a short distance above the finished surface of the pavement so that later it will iron out over the joint and protect the edges of the concrete. It is difficult for the average workman to finish the concrete on both sides of the tarred felt at the same level where this felt extends from ¼ to 2 in. above the finished surface of the pavement. To obviate this difficulty the split float was designed. It consists of two small wooden floats spread about ½ in. and connected by a handle.

EXPANSION JOINTS

When protection plates at transverse expansion joints are used the plates do not always arrive on the job in satisfactory condition, for the rough handling they receive in shipping will sometimes bend them out of shape. To bend out the shear anchors of steel plates, use a 36-in. length of 1½-in. pipe. It is a good idea to give the prongs a half turn after they are bent up—a monkey wrench is a convenient tool to use for this purpose. For wide pavements the installing device will sag a certain amount so that in making up a joint, three "horses" may be necessary and when the workmen set the tee-installing bar on them, they should stretch a chalk line over the ends and raise or lower the center horse until the crown at the center of the bar is correct. The workmen can then proceed to fit the steel plates to the tee-bar and know that when they fit they are correct for the crown.

Plates as they come from the factory are not always uniformly curved and must be "pened" out with a hammer. A 3-lb. ball pene or machine hammer is most satisfactory and a small anvil or length of railway rail is convenient. Very often when the plates are placed on the tee-bar they touch it in several spots only throughout its length. Hammering down the edge of the plate will have no effect whatever on the Baker type, but if the plate is laid flat on an anvil and the ball end of the hammer is used to strike at the points where the plate does not touch the bar, the plate will be expanded at those places and so will conform to the proper curve with one or two trials. It is important to have this done, as otherwise the steel will catch on the strikeboard in places and leave hollows in others, will look very bad and will not provide adequate protection.

In placing a joint on a wide street with a tee-bar installation there will be some sag at the center. This may be prevented by the use of a pin having a lug upon one side. The pin is driven and the lug is set by measuring from a line stretched from one side of the pavement to the other over the forms or curbs so that it will be at the exact elevation desired for the surface of the finished pavement. The tee-bar, when set in place, rests upon the lug. It may be necessary to use three of these pins, one at the center of the street and one at each of the quarterpoints. Wooden stakes are often forgotten and left in the pavement. The iron stake can be given a quarter turn to release the shoulder and will never be forgotten because it projects above the concrete.

Believes in Eliminating Concrete Road Joints

No Joints Except at the End of Day's Work and Addition of Hydrated Lime to Reduce Porosity Are Recommended

PAST experience in Illinois now points to the advisability of building concrete pavements with no joints except at the end of each day's work. This statement was made in a paper by H. E. Bilger, Illinois State road engineer, presented Jan. 29 to the Illinois Society of Engineers and Surveyors.

When a satisfactory method of surfacing the concrete pavement has been worked out, the troubles now arising from joints and cracks will have been reduced to a minimum. With regard to the spacing of transverse joints in a concrete pavement, our experience has been that the matter is not yet susceptible of mathematical analysis. True it is that computations have been made involving such factors as physical properties of the concrete, and friction coefficient between the concrete and the subgrade, but experience seems to indicate that the behavior of the pavement in actual service is not such as to be predicted by mathematical computations.

The occurrence of transverse cracks has been almost as erratic in pavements with the joints spaced 50 ft. apart as in those spaced 100 ft. apart. At the end of each day's work the end of the slab should be faced with a piece of wool felt, possibly $\frac{1}{8}$ in. in thickness. This would permit concreting to be resumed the next day with the least disturbance to the concrete previously placed. It is not to be expected that a slab of concrete some 7 in. in thickness, and several hundred or several thousand feet in length can undergo the process of setting up hard without yielding to the shrinkage stresses necessarily introduced by the high consistency of the concrete. It is believed that the occurrence of transverse cracks cannot be entirely forestalled by any considerations of the subgrade when a concrete of high consistency is used, and that the occurrence would be almost equally probable and erratic if the concrete pavement were uniformly supported upon a liquid bearing throughout its entire length. It would seem that the difficulties are inherent in the nature of the material, but in all probability can be reduced by using a lower consistency and by the addition to the cement of a percentage of inert material, such as hydrated lime, for the purpose of reducing the voids in the concrete without affecting its physical qualities.

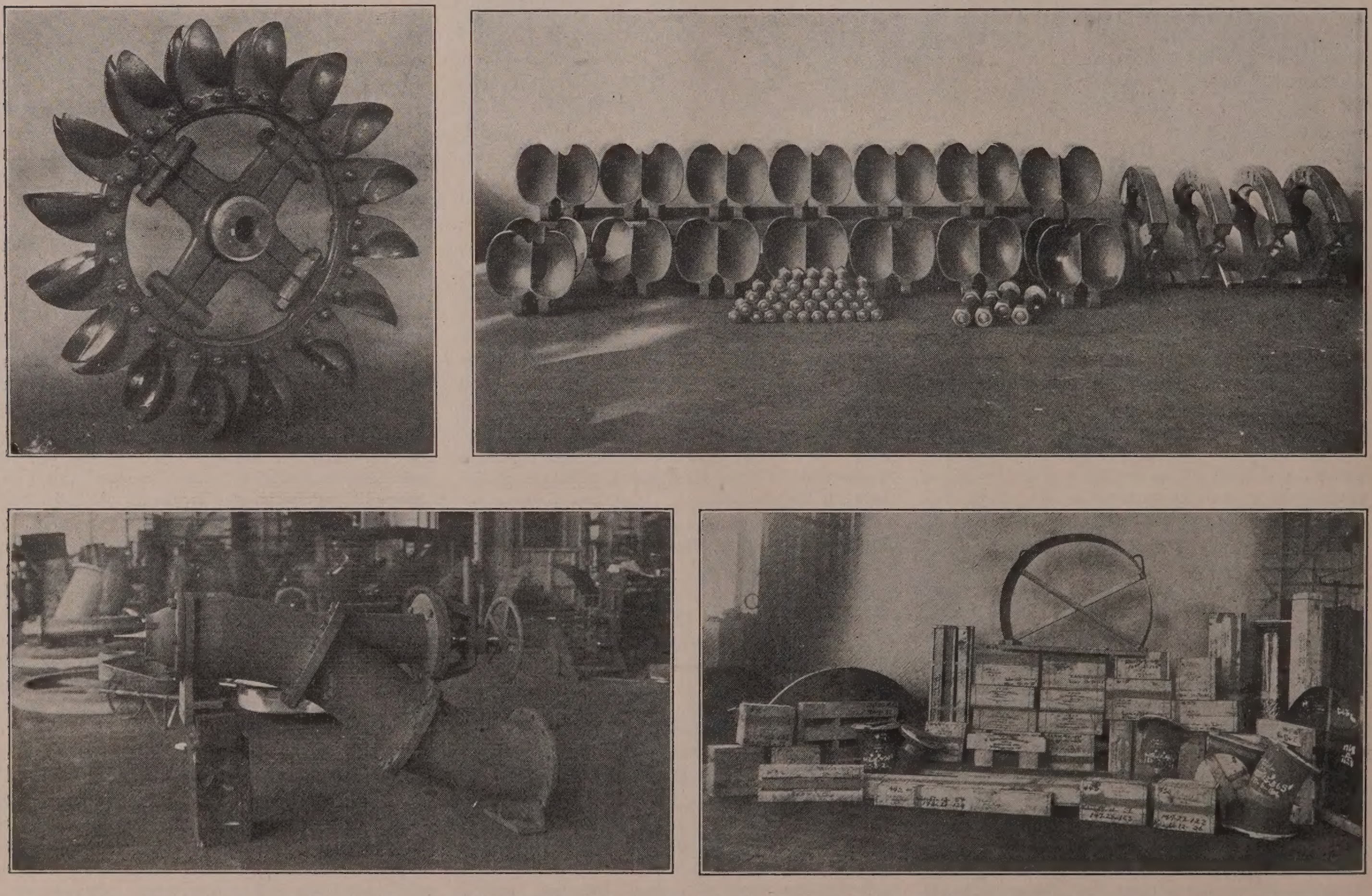
Waterwheel Designed for Mule-Back Transportation

Exceptional Requirements of Packing for Export Forces Manufacturer to Sectionalize Prime Mover—Runner Consists of 56 Parts

A 100-HP tangential waterwheel, built in units to enable its transportation on mules' backs through the wilds of Mexico, is shown in the accompanying photographs. The wheel will be directly connected to an air compressor at the mines of the Estaca Mining Company. The case is a good example on what problems have to be faced occasionally by manufacturers who cater to the export trade.

RUNNER IN 56 PARTS

The first photograph shows the runner assembled at the shops and the second shows it knocked down for packing. All told it consists of 56 parts as follows: 4 quadrants forming the wheel; 4 bolts for holding these quadrants together; 16 buckets; and 32 bolts for securing these buckets to the wheel. The third illustration shows the reverse curve needle nozzle assembled and the method of sectionalizing is plainly visible. Including the bolts the nozzle consists of 53 pieces. The last photograph shows the entire equipment boxed and ready for shipment, including the plate steel water wheel housing and the reducer for connecting the nozzle to the penstock. Each package is properly numbered. The gross and net weight in pounds and kilos and the cubic capacity are given and the purchaser's private mark is displayed. The water wheel was built and shipped by the San Francisco shops of the Pelton Water Wheel Company.



RUNNER ASSEMBLED AND IN PARTS, NEEDLE NOZZLE AND WATERWHEEL KNOCKED DOWN AND BOXED FOR MULE-BACK SHIPMENT

Yardage Record at Kensico Dam Due, in Part, to Operation of Mixers

By Placing 489,000 Yards of Cyclopean Masonry in 1914 the 1913 Performance Was Exceeded by 173,000 Yards

By GEORGE T. SEABURY
Principal Assistant Engineer, New York Board of Water Supply

THE unusual volumes of masonry placed during the summer of 1913 in the Kensico dam at Valhalla, N. Y., for the Board of Water Supply of the City of New York were far exceeded during 1914. The results achieved last year place this work, it is believed, at the very head of all construction feats of this nature.

The construction methods on the Kensico dam were described at length in the Engineering Record of June 10, 1914, where the relation of the structure to the general scheme of the Catskill water system was outlined. The geological features of the foundation and the difficulties of the excavation were discussed and the general plant layout employed by the contractor in placing the 316,000 cu. yd. of masonry in the season of 1913 were described in detail.

At the close of the 1913 work the dam was approximately level at El. 214.5 for a length of 860 ft. and with a width, at that elevation, of 132 ft. At the two ends of this plane were the sloping hillsides where practically no masonry had been built. During the winter of 1913-14 backfill was placed on both sides of the dam up to the top of the then completed work. It was from this level plane that the work of 1914 started on March 17, and on Dec. 2 the dam was completed to its top, 155.5 ft. higher, for a length of 1388 ft. During 1914 there were placed 489,800 cu. yd., making a total of 805,800 cu. yd. of cyclopean masonry and concrete blocks placed in the 2 yr.

The plant, throughout the work of both seasons, has consisted of a system of travelers, equipped with derricks, and of a group of guy derricks, all served by shuttle cars conveying the concrete in buckets from the favorably located mixing plants. In 1914 the guy derricks were confined generally to the work at the ends of the dam, leaving the middle portion to be built by the travelers. The travelers, about 40 ft. square, were each equipped with two derricks with booms 57 ft. long and operated by double-speed electric hoists. The travelers ran on tracks elevated above the work on piers which were incorporated in the mass of masonry. The shuttle cars consisted of a flat car carrying a vertical steam boiler directly connected to a simple engine operating a chain which engaged a sprocket on one of the axles. There were but three mixers used the entire year. These were located at three of the four corners of the work completed in 1913, two of the mixers being on the downstream side of the dam and the third on the upstream side, at the east end.

WORK IN 25-FOOT LIFTS

The dam is designed with expansion joints, in general 79 ft. apart, with one side composed of pre-cast blocks laid up as in a wall. This permits the section contained between two joints to be built to any given height as a separate unit. The work this year consisted of the building of the third, fourth, fifth, sixth, seventh and eighth "lifts," each about 25 ft. in height. To these same general levels the work of the guy derricks was made to conform so far as possible, thus permitting the use of the travelers over a greater area as the dam increased in length near its top.

In the third lift, the first one placed last year, the width was sufficient to permit two travelers to operate side by side, faced by two others, thus making eight derricks available at a section. For these, five service tracks were provided. In the fourth lift, with top at El. 264.5, and for all the work above, the cross-section was so narrow that two travelers could no longer be used abreast, and thereafter but four derricks were engaged at a section. The cyclopean stone and the blocks were handled by the upstream derricks from one of the two service tracks on the upstream side of the dam, and the concrete from the other track and two service tracks on the downstream side.

In the eighth lift, which, instead of the usual rise of 25 ft., was 30.5 ft., and which carried the work to El. 370, the very top of the dam, it was not possible for the travelers to be placed above their work as was usual, and they remained therefore at El. 339.5 and built from there as high as their booms could reach. After the first section was built in this way only one traveler was retained at a section, assisted by a guy derrick placed on top of the last completed section.

SUPPORT OF TRAVELER TRACKS

The traveler tracks at the very first of the work were carried on girders supported on piers made in the block yard and brought to the dam. Later these were replaced by somewhat larger piers made in place, and in the work of this year the piers were made of concrete blocks. A 10-ft. section of the expansion joint facing was built up to full height with the usual arrangement of headers and stretchers. For the tails of the headers narrow support blocks were made and placed with mortar joints, forming a web. Midway between the joints the girders were supported on stout pyramidal timber horses which, with the girders, could be entirely removed from the section being worked, thus affording no obstacle whatever to the swinging into position of buckets and stone.

As the more narrow part of the dam was reached it was possible to build to a greater height than 2½ ft. a day, the rise of one course of blocks. The arrangement of the blocks was then changed permitting the alternate courses to be without headers. Still later this rise of 5 ft. was insufficient and a third course was built with the headers supported by filler blocks and permitting, if needed, a fourth or stretcher course to be built.

MIXERS AN IMPORTANT FACTOR

Three mixers of the Hains-Weaver gravity type, of nominally 2½-yd. capacity, were used in 1914. The average batch, however, had a volume of 52 cu. ft. of fluid concrete. It was the study of the arrangement of these mixers and of their operation that, to a considerable degree, made possible the really remarkable progress attained. Each mixing plant had nearby a large bin for the storage of sand and stone and was also surmounted by a small bin for the same purpose. These bins were connected by belt conveyors, the longest one of which was 340 ft. in length between end pulleys. Sand and stone were fed alternately to the belts and deflected to their respective bins at the mixer by a switch. The cement was kept in the original cars which were brought on a standard-gage spur to the side of each mixer and from which the bags were supplied to the mixer by chutes or belt conveyors.

The organization of the mixing gangs when going at top speed consisted of 6 men bringing cement to the side of the hoppers and 6 more men filling them with stone, sand, cement, and applying the water. The last mentioned 6 men were under an overseer, who directed their operations, giving the word for the addition of the water and for the opening of the measuring hopper doors. Two men cut the tapes on the cement bags and got them into position for quick handling, and two more men were needed to remove the empty bags. At the hoppers below were the three regular men, and when it was required to chute in different directions a fourth man was needed for that operation alone. At the bins above the mixing platform, one man was stationed to look out for the supply of the sand and stone, and another man, located under the large storage bins, fed the aggregate to the conveyor in response to his signals.

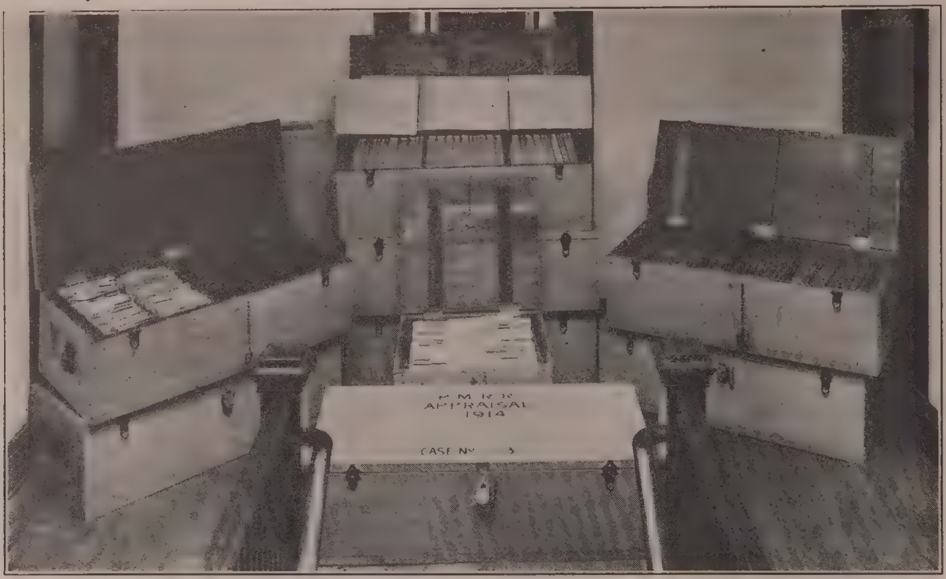
653 BATCHES IN 8 HOURS

The largest output of one mixer for a single day in 1913 was 384 batches. This year, under the improved conditions and the stimulus of the bonuses offered, the number of batches grew larger and larger until a maximum of 653 batches was obtained in 8 hr. At 52 cu. ft. per batch, this is equivalent to 157.2 cu. yd. per mixer-hour or 2.62 cu. yd. per minute.

The maximum volume of masonry built in the best month this year was that between July 25 and Aug. 24, when 84,450 cu. yd. were placed. Of this, 7810 cu. yd. were blocks previously made and placed at night, and 1630 cu. yd. were cyclopean masonry placed in a second shift operated a few nights, and includes a little work done on one Sunday. The remaining 75,010 cu. yd. were placed in the 26½ working days, of 8 hr. each. In this month, therefore, there was placed a daily average of 3125 cu. yd. Considering, however, only the 75,010 cu. yd. of cyclopean and mass concrete placed in the regular 8-hr. day shift, there was an average of 2831 cu. yd. of masonry placed per day, or 353.8 cu. yd. per hour, which figure, it appears from the letter of J. Edward Cassidy, published in the Engineering Record for April 4, 1914, exceeds considerably even the best records made on the remarkable work at the Panama locks.

The contractor for the work is H. S. Kerbaugh, Inc., of Philadelphia, for whom Beverly R. Value is chief engineer, and George H. Angell, superintendent. J. Waldo Smith is the chief engineer of the Board of Water Supply.

THE CHILEAN TRANSANDINE RAILWAY rises 7776 ft. in a total length of 44 mi. There are 14 mi. of rack section, with grades of from 5 to 8 per cent.



TEN LARGE BOXES WERE REQUIRED TO CONTAIN THIS APPRAISAL REPORT

Appraisal Report of Pére Marquette Railroad Fills Ten Large Boxes

Figures Much Above Those of Earlier Evaluations Because of Greater Accuracy, Numerous Improvements and Increased Unit Values

TEN BOXES, with an approximate capacity of 50 cu. ft., were required to contain the report of Prof. M. E. Cooley, dean of the engineering department of the University of Michigan, on the valuation of the Pére Marquette Railroad, recently submitted to the Michigan Railroad Commission. In Professor Cooley's nineteen-page letter of transmittal he states that six months were given to the work, with a larger force to cover the less than 3000 mi. of the Pére Marquette system alone than was used in his appraisal of all the railroads in Michigan in 1900. Ten parties of three men each were engaged three months on track inspection, and six parties of three men each four months on earthwork. Each of these parties was in charge of an experienced railroad engineer, his instructions being to do the work with such care as would enable him to testify in court as to its correctness. The same care was used in collecting the data on mechanical and marine equipment, and in the land department of the work. The records have been arranged and filed with special reference to their convenient use by any competent engineer in connection with any special investigation in the future.

PHYSICAL VALUE OF PLANT ONLY

"In making this appraisal," states Professor Cooley in his letter of transmittal, "the following objects have been kept in mind:

"1. To secure complete and accurate data of all properties owned by the company; to inspect every item of these properties and make a full description of them, and to secure their histories and all information as to their original character and costs.

"2. To make a correct and conservative estimate of the cost of reproducing new the properties in actual use for railroad purposes as they existed July 1, 1914. Thus there is not included in the results reported any property not now in actual use for railroad purposes, nor any costs or values to cover franchises, non-physical elements or so-called 'going-concern.'

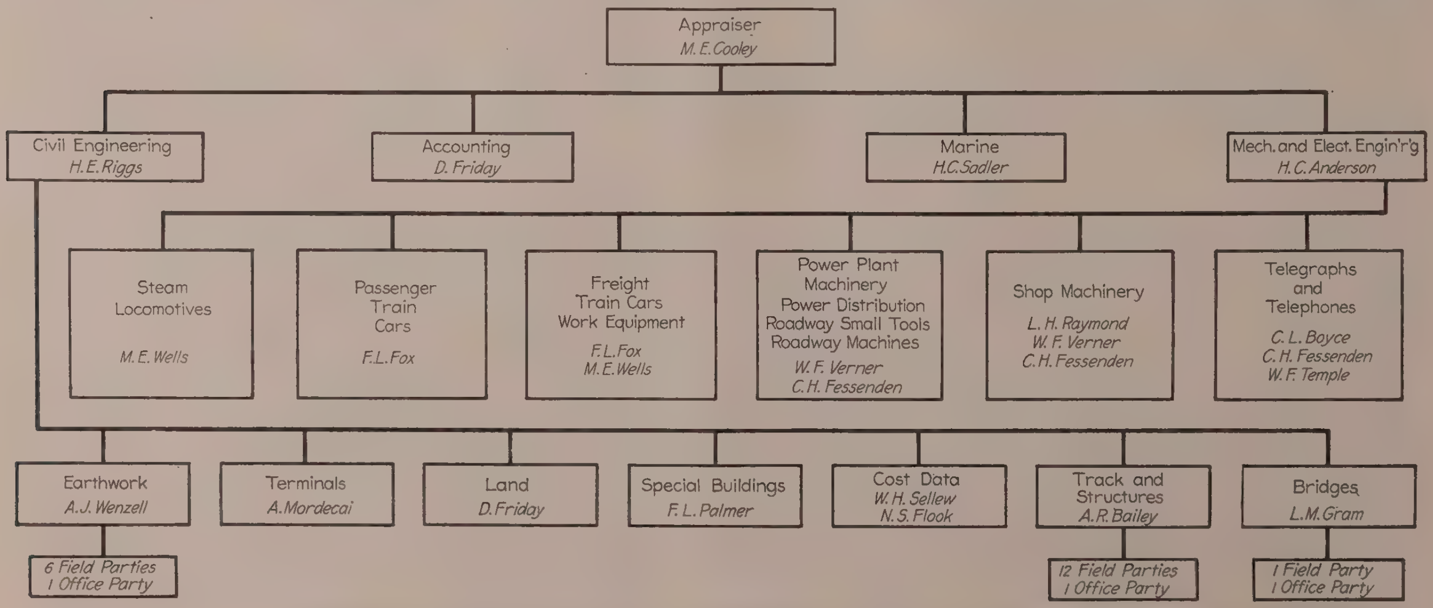
"3. To analyze carefully the different items of property in order to determine their present physical condition, taking into account their age, wear-and-tear due to use and exposure to the elements, and their serviceableness and adequacy for present day use.

"The result arrived at by taking into consideration the depreciation of the physical elements shows the condition in which the property is being maintained. In the case of the Pére Marquette the properties have been found to be maintained in an average condition of 81 per cent of what it would cost to reproduce the properties out of all new elements. It may be said in passing that the average condition of all the railroads of Michigan found in the appraisal of 1900 was 82.08 per cent.

"In order to make entirely clear what this appraisal means, it may be stated that the work has been handled simply as an engineering problem. It has not been attempted to determine any value based on earnings, to fix the proper amount of capital which may be issued against the property, or to arrive at any conclusion concerning the value of the property as it may have been affected by the various reorganizations during recent years."

GREAT INCREASE IN ESTIMATED VALUE

As stated in a note in the Engineering Record of Jan. 16, page 73, the physical value of the plant, based on the reproduction cost new with a deduction of 19.42 per cent for depreciation, is given as $78,545,241. Three previous appraisals of the property have been made by Professor Cooley, in 1900, 1902 and 1905 respectively. In order to bring the four to a uniform basis it is necessary to eliminate from the 1914 appraisal the lines outside of the State of Michigan, and to make other adjustments. On that basis the present value of the property in Michigan only is given as $64,349,449, this figure exceeding by



FOUR MAIN DEPARTMENTS HANDLED WORK; CIVIL ENGINEERING SECTION WAS SUBDIVIDED INTO SEVEN HEADS

$21,946,140 the estimated value in 1905, which was greater than in 1902 or 1900. Professor Cooley states that "perhaps the most obvious reason for the marked increase in the 1914 appraisal over the former appraisals is the greater care taken in making it. In 1900 the entire appraisal of all the railroads of Michigan, embracing a total of nearly 11,000 mi. of track, was practically completed in 120 days. The work was authorized August 27, 1900, and had to be completed before the legislature met in January, 1901. While more time was taken in the 1902 appraisal, the roads were not reinspected, and the appraisal of that date was based primarily on the 1900 appraisal. The same is true of the 1905 appraisal, except that, as I recall it, the work was completed in about one month's time."

MANY ADDITIONS AND BETTERMENTS

The total track mileage in Michigan only increased from 2351.33 mi. in 1900 to 2586.79 in 1914. In that time, however, states Professor Cooley, there have been many additions and betterments. Hundreds of old wooden bridges have been replaced by modern steel-concrete structures; hundreds of miles of main-line track have been relaid with 75, 80 and 90-lb. rail, taking the place of 56 and 70-lb. rail; automatic block signals have been installed on a part of the system; large additions to facilities for doing business have been built, including new coaling stations of modern design and new shops at Wyoming. The 1914 classification also includes many items not found in earlier classifications, such as sewers, paving and other improvements built by assessment.

In the items of land, grading, ties, rail and equipment the greatest gains in value are shown, these five items embracing 74 per cent of the increase since 1905. In that interval the right of way has doubled in value and the value of the grading has more than doubled. "As a basis for computing the earthwork in 1914," states Professor Cooley in his letter of transmittal, "actual measurements were made in the field, while in former appraisals approximate data had to be used. The company had no records of the amount of earth actually moved. The earlier appraisals were therefore based on profile estimates for a part of the lines, and for other parts on field estimates made by an engineer going over the road at the rate of 12 or 15 mi. a day, estimating mile by mile without measurement. This year the field parties cross-sectioned all earthwork at frequent intervals. It is interesting to note that on such sections of the road as it was possible to check with the original quantities it was found that the 1914 estimates were within 2 or 3 per cent of the actual quantities paid for."

The company's ties also have twice the value recorded in 1905, while rail values have increased almost 40 per cent and equipment values nearly 20 per cent.

ITEMS NOT PREVIOUSLY INCLUDED

"Important items in the 1914 results," continues the letter, "are the increases in the costs of materials and labor. The general effect of these increases is so well known as to require no particular explanation. Another item is that in the earlier appraisals the cost of transporting construction materials to the places of their use was not included, at least not in any adequate amount. In the 1914 appraisal these costs were made the subject of special investigation and found to be far greater than any allowance made for them in former appraisals. Likewise, as the result of special investigation, it was found that the actual costs of many items as shown on the books of the company included only a part of the expense; for instance, the cost of concrete in bridge abutments was shown at only the contractor's figures, which did not include the transportation of materials, sheet piling, if required, or unwatering, nor did it include the transportation of men and many other things which it has been customary for railroads to do in connection with building operations. That is to say, railroads have in the past charged to operation many items which properly were chargeable to construction. These and the many other items which a more detailed analysis would disclose explain the marked increase in values of the physical properties in the present appraisal over those of previous years. It confirms the experience in other States in which recent appraisals of railroad properties show unexpectedly high results.

NO APPRECIATION FIGURED

"In a number of important railroad appraisals in other states 10 per cent has been added to the grading schedule to cover appreciation due to solidification and improvement of surface due to sinking of ballast. Nothing has been added in this appraisal. If done it would add $1,025,135 to both the cost of reproduction and to this cost less depreciation.

"Attention should also be called to the so-called overhead charges. In general they are less in the 1914 appraisal than in

APPRAISAL VALUE OF PERE MARQUETTE SYSTEM AS OF JULY 1, 1914

I. C. C. account number	Schedule	Cost of reproduction	
		New	Less depreciation
	I—Road		
1	Engineering (See 1-A and 1-B below)	....	....
2	Real estate	$11,959,040	$11,959,040
3	Grading	11,282,635	11,282,635
4	Underground contact construction	0	0
5	Tunnels and subways	0	0
6	Bridges, trestles and culverts	4,099,461	3,455,228
7	Elevated structures	320,396	193,991
8	Ties	6,125,509	3,382,142
9	Rails	9,465,494	7,084,675
10	Other track material	2,046,286	1,334,867
11	Ballast	1,417,127	1,417,127
12	Track laying and surfacing	3,165,257	3,165,257
13	Right-of-way fences	1,061,111	518,654
14	Snow and sand fences	17,856	7,561
15	Crossings and signs	389,827	296,146
16	Station and office buildings	2,791,476	1,997,028
17	Roadway buildings	111,768	65,162
18	Water stations	537,933	374,681
19	Fuel stations	192,337	163,068
20	Shops and engine houses	1,781,232	1,371,092
21	Grain elevators	0	0
22	Storage warehouses	0	0
23	Wharves and docks	281,583	195,488
24	Coal and ore docks	0	0
25	Gas-producing plants	0	0
26	Telegraph and telephone lines	233,698	165,332
27	Signals and interlockers	386,830	277,590
28	Power dams, canals and pipe lines	0	0
29	Power plant buildings	16,550	14,896
30	Power substation buildings	0	0
31	Power transmission systems	0	0
32	Power distribution systems	2,100	1,785
33	Power lines, poles and fixtures	0	0
34	Underground conduits	0	0
35	Miscellaneous structures	166,922	91,520
36	Paving	18,415	13,811
37	Roadway machines	46,916	37,499
38	Roadway small tools	17,585	13,189
39	Assessments for public improvements	200,748	200,748
40	Revenues and operating expenses during construction	0	0
41	Cost of road purchased	0	0
42	Reconstruction of road purchased	0	0
43	Other expenditures—Road	0	0
44	Shop machinery	583,988	495,303
45	Power-plant machinery	110,340	94,797
46	Power substation apparatus	0	0
47	Unapplied construction material and Supplies	....	....
	Total—2 to 47, inclusive	$58,830,420	$49,670,312
47-A	Contingencies (7½ per cent of items 3 to 47, inclusive)	3,515,353	2,828,345
1-A	Engineering on roadway and structures (3½ per cent of items 3 to 47-A, inclusive)	1,763,536	1,763,536
	Total road	$64,109,309	$54,262,193
	II—Equipment		
51	Steam locomotives	$5,440,092	$3,908,815
52	Other locomotives	0	0
53	Freight-train cars	12,604,017	7,660,841
54	Passenger-train cars	2,449,268	1,729,582
55	Motor equipment of cars	0	0
56	Floating equipment	2,380,000	1,322,300
57	Work equipment	257,032	188,081
58	Miscellaneous:		
	Total—51 to 58 inclusive	$23,130,409	$14,809,619
58-A	Contingencies: (3 per cent of items 51 to 58 inclusive)	693,913	444,289
1-B	Engineering on equipment: (2 per cent of items 51 to 58-A inclusive)	476,485	476,485
	Total equipment	$24,300,807	$15,730,393
	III—General Expenditures		
71	Organization expense: (½ of 1 per cent on road and equipment)	$442,051	$442,051
72	General office and clerks: (½ of 1 per cent on road and equipment)	442,051	442,051
73	Law: (½ of 1 per cent on road and equipment)	442,051	442,051
74	Stationery and printing: ($10 per mile)	21,361	21,361
75	Taxes	644,050	644,050
76	Interest during construction: (6 per cent on road and 2 per cent on equipment)	4,332,575	4,332,575
77	Other expenditures—general insurance: (2/10 of 1 per cent on road and equipment)	176,820	176,820
	Total general expenditures	$6,500,959	$6,500,959
	Stores and supplies: (Book value Sept. 14, 1914)	1,051,696	1,051,696
	Working capital: (See Note A)	1,000,000	1,000,000
	Total equipment	24,300,807	15,730,393
	Total road	64,109,309	54,262,193
	Grand total	$96,962,771	$78,545,241

Note A—Estimated proper amount necessary for a new road of the same class but without financial history. Actually the Pére Marquette Railroad's current liabilities exceed its current assets by $7,102,583.

former appraisals. This is due primarily to the fact that the greater amount of time available in 1914 has made it possible to make more complete inventories, to work up unit costs more carefully, and to make investigations fixing more accurately a number of the individual percentages. In general the overhead charges in the 1914 appraisal aggregate about 15.4 per cent on the entire property, as against 18.4 per cent in former appraisals."

The accompanying table gives the new and depreciated values of the whole property classified according to Interstate Commerce Commission requirements. The organization of the work is indicated by the accompanying chart, and the magnitude of the report is suggested by the photograph.

Change of Runners Permits 100 Per Cent Head Increase

Turbines of Nolachuckey Hydroelectric Plant Were Designed for Initial Head of 34 Feet, with Future Increase to 70 Feet

A HYDROELECTRIC plant in which the waterwheels were built in such a way that, when the head on the installation in the future is increased about 100 per cent, the only change required to meet the new conditions will be to exchange the runners, was described by W. V. N. Powelson, consulting engineer, of New York City, in a paper entitled "Financial Safety in Water Power Development, including a description of the Nolachuckey Hydroelectric Plant of the Tennessee Eastern Electric Company," and presented Dec. 31, 1914, in Philadelphia, before Section D of the American Association for the Advancement of Science.

Because of the flood conditions the generators had to be set 35 ft. above low water. The vertical type of unit was adopted, with the center of the wheel placed 19 ft. above low water. The power-house is designed for four units of 4000 hp capacity each under a head of 70 ft.

The novel feature lies in the selection of the size and type of the generating units. While the existing market was small, there were excellent reasons for expecting increases of substantial amounts, and if such increase should require raising the dam to produce a 70-ft. head, it was desirable to avoid the losses incident to buying generating units for a 34-ft. head (the head on the first installation), which would not be useful under a head of 70 ft. and which might have to be scrapped in a short time—possibly within two or three years.

The suggestion was made to the makers of waterwheels that it was desired to put in wheels which, by a change of runner, would operate satisfactorily under heads ranging from 34 to 39 ft. or from 60 to 70 ft. The speed under both conditions of head was to be the same so as not to change the frequency of the current supplied by the generators, which would be installed initially of full size. The underlying idea was that if this could be done without too great a sacrifice in efficiency it would make it possible to install initially the same generating unit that would be ultimately required, with the single exception of the runner.

When the plan was developed it was found that the sacrifice in efficiency was small.

A small reduction in efficiency of the unit under the lower head would not affect the net earnings of the company, because by the time so much of the capacity of the initial installation had been sold, so as to make the sacrifice in efficiency felt, the work on raising the dam would undoubtedly be under way. On the other hand the small reduction in efficiency in the wheels, when operating under the 70-ft. head, would not amount to much until the full capacity of the ultimate development had been sold, and then only during the period of the year when there was no waste water running over the dam. At these times the wheels last installed and designed for the 70-ft. head, having presumably the highest efficiency, would take the greater part of the load, and the two units first installed would be used to pull peaks and as a spare. The possibility of a small decrease of 1 or 2 per cent in efficiency under the 60 to 70-ft. head did not cut a figure in the practical earning capacity of the company. As a matter of fact the curves of performance under 60 to 70-ft. head for the runners furnished by the makers and based on Holyoke test 2229, showed maximum efficiencies running between 88 and 89 per cent.

The guaranteed efficiencies were as shown in the table, and are practically the same under considerable variation of head when drawing down the pond of the ultimate development.

Guaranteed Efficiencies in Per Cent at Speed of 164 r.p.m.

	Head in Ft.							
	First Runner				Second Runner			
	34	36	38	39.5	55	60	65	70
Full load	80	79.5	79	79	81.5	82	82	81.5
Seven-eighths	82	82	81.5	81	84	84.5	85	84.5
Three-quarters	80	80	79.5	79	83	83.5	84	83.5
One-half	72.5	72	71.5	71	75	75	76	75

The order for the units was placed with the Allis-Chalmers Manufacturing Company for several reasons, principally because they were in a position to make a fixed-sum bid under satisfactory specifications on the complete unit,—generator, exciter, waterwheel and governor,—erected, tested out, and ready for regular operation on the line.

Plate Steel Scroll Case

The novel feature of the unit is the scroll case, which is made of plate steel. The casing is of circular cross-section and decreases in diameter as water leaves it to enter the turbine gates. It is built up of conical sections, lap-jointed and riveted together. It is economical in material and low in friction losses, and being circular in section the deformation under water pressure is a minimum. The casing is held together on the side of the water exit by a speed ring of cast steel. The discharge of the unit is controlled by gates of the outside wicket type. The spiral was set, riveted up and then concreted in up to the center line.

This installation is believed to be the first of this type. The cases were first assembled in the shop and then knocked down and shipped in four sections. The inlet of the spiral is 9 ft. in diameter. Cases are now being constructed of this type with an inlet of 13 ft. diameter for use under 100-ft. head giving about 8500 hp.

The weight of the rotor is taken on a bearing of the Allis-Chalmers type mounted on top of the generator housing. The runner is made up of steel vanes and cast iron central hub and cast iron outer ring. The operating mechanism is all external and subject to easy inspection and repair.

The exciters are belt-driven from a pulley driven by spur wheels on the main shaft. This plan was used because it was a positive and reliable way to get excitation for the generators and saved a substantial sum over any other scheme. Later on, when the business grows, it is intended to use motor-generator sets for the continuous excitation and belt driven exciters for starting. The driving spur wheels on the main shaft have removable wooden teeth, and the noise of the gears is not excessive. The excitor system has worked well.

Limits Manhattan Pavements to Three Standard Types

H. W. Durham, Chief Engineer of Highway Bureau, Advocates in Annual Report Only Granite, Sheet Asphalt and Wood Block —Asphalt Block Eliminated

BY limiting its selection to only three types of pavement—granite block, sheet asphalt, and wood block—the Borough of Manhattan of New York City can carry out its paving plans to the best advantage and need not concern itself with other types of surfacing, particularly asphalt block, which has not given satisfactory service under heavy traffic in any street of the borough. This is the opinion expressed by Henry Welles Durham, chief engineer (until Feb. 1) of the Bureau of Highways, in his annual report for 1914.

Improvements in 1914

Among the improvements adopted by the bureau last year were 12-ft. radius curves at corner curbs, instead of the old 6-ft. curves; storm-water inlets on both sides of curb intersections, instead of a single large basin at the corner; granite for curbs, instead of bluestone or other materials. Increased vigilance has been exercised in supervising construction, close-jointed granite block pavement between rails of car tracks is now specified and unbalanced bidding has been eliminated to a large extent.

There still remain opportunities for improvement in the work of the highway bureau. Mr. Durham suggests the advisability of inaugurating a plan of percentage bidding on a carefully prepared schedule of unit prices and total quantities. More finely graded sand than that now used is desirable for mixing with the bituminous filler for granite block pavement. It is recommended also that New York adopt the foreign method of laying wood-block directly on a smooth concrete base and that in the asphalt specifications the mineral aggregate be more closely graded.

The chief engineer of the Bureau of Highways is frequently called on to supervise contracts, the preliminary preparation of which has been entirely outside of his control. This condition, Mr. Durham points out, should not exist. Then again, certain members of his organization, nominally under his direction, are not subject to his complete authority. Particularly is this the case with respect to street openings where an illogical system provides for corporation inspectors, generally men without technical training, whose appointment is beyond the jurisdiction of the chief engineer and who have divided allegiance.

Asphalt Blocks Condemned

Mr. Durham discusses at some length New York City's experience with asphalt blocks. Where this type of pavement has been laid under heavy traffic conditions in the Borough of Manhattan, he says, it has failed to give satisfactory service. Figures have been presented to show that the present pavements of asphalt block in Manhattan are being maintained at a less average cost per square yard than those of sheet asphalt with which type asphalt block naturally competes. In interpreting these figures, however, it must be borne in mind that a large majority of the asphalt block streets is in the northern part of the borough where traffic is comparatively light. The figures for the asphalt block are not, therefore, to be compared with the average for sheet asphalt maintenance throughout the entire borough, but only with that in the corresponding sections of the city. If this is done, according to Mr. Durham, no advantage on a maintenance cost basis is shown.

The claim that asphalt block is less slippery than sheet asphalt is unfounded, according to Mr. Durham. Asphalt block has the advantage that it may be laid like any other block pavement and the advantage of uniform structure pertaining to all bituminous composition pavements. It has the disadvantage that the individual blocks are not composed of solid hard material and hence are not rigid or able to maintain their original shape under pressure or change in temperature and in consequence have not the repair advantages of sheet asphalt. It must be prepared by substituting individual blocks for those removed; the new blocks generally do not conform to the altered shape of the pavement. On many asphalt block streets instances can be pointed out where the material has traveled, in some instances, many feet, in the same way that sheet asphalt does in hot weather, but unlike sheet asphalt the defect cannot be remedied by cutting out and replacing with new material. No instance can be shown, Mr. Durham states, where asphalt blocks have continued to have a satisfactory surface under dense traffic similar to that shown for many years by sheet asphalt on Fifth Avenue.

The greatest drawback to asphalt block pavement, according to Mr. Durham, has been its repair after several years of service. The advocates of asphalt block recommend for its repair the removal of the pavement over large areas where worn, sorting out such of the blocks as can be used again and laying these culls altogether in repaired areas, the remainder being surfaced with new blocks. Such a method of repairs presupposes large defective areas, which in turn runs counter to arguments as to the desirability of prompt maintenance down to the smallest defect and the relatively low percentage of asphalt block to be resurfaced as compared with other types of pavement.

CHANGES IN SPECIFICATIONS

Granite Block.—The joint filler for granite block pavement was modified to provide for a mixture of hot sand and paving cement. This has proved very satisfactory as the introduction of sand has given the filler sufficient body to allow the omission of the previous requirement that the joint should be filled with sand for a depth of 3 in. previous to pouring. The old practice resulted in an excess of sand and a shortage of paving cement.

Sheet Asphalt.—The sheet asphalt specifications, while satisfactory, according to Mr. Durham, can be improved by some future variations resulting in a closer grading of the mineral aggregate which forms the actual wearing surface, but as they stand represent an almost ideal surface for such busy streets as Fifth Avenue, where smoothness, cleanness and ease of making repairs are essential.

Wood Block.—The specifications for wood block have been modified to the extent of reducing the amount of oil with which the block is impregnated from 20 to 18 lb. per cubic foot and providing for a bituminous joint filler in place of cement grout.

Asphalt Block.—This class of pavement has been eliminated from among the standards for the Borough of Manhattan.

One of the features of the year's work was the economy effected by making repairs to sheet asphalt pavements with a municipally owned and operated asphalt plant placed in operation May 25, 1914. A total of 129,877 sq. yd. of sheet asphalt was laid in 1914 by the municipal plant, while 114,793 sq. yd. was laid by contract. The contract price for doing the work averaged $1.47 per square yard, while the price for the municipal plant work, including an overhead and depreciation charge of 18.4 cents per square yard, was 99.8 cents per square yard. This shows an actual saving amounting to $61,627 on the yardage laid by the plant.

Value of Paving Materials Disclosed by Two Years' Service Test in New York

Condition of Twenty-one Sections of Various Types Indicates Superiority of Granite, Sheet Asphalt and Wood Block, According to H. W. Durham

FROM a recent examination of the condition of twenty-one sections of the test pavement laid on Second Avenue, New York, in 1912, Henry W. Durham, chief engineer (until Feb. 1) of the Bureau of Highways of the borough of Manhattan, concludes in his 1914 annual report, just submitted, that granite, wood block, and sheet asphalt have given the most satisfactory service. A minimum amount of restoration due to ordinary wear and tear or defects other than damage from street openings has taken place in the pavements of these three types after 2 yr. of service. The worst results were observed on the European rock asphalt section. The sandstone block section also required extensive repairs, as did the asphalt block sections. The Australian hard-wood blocks were absolutely unsatisfactory. All classes of wood block pavement, Mr. Durham states, bled profusely the first season and very little the second. The description of each section and an estimate of its condition, as observed by Mr. Durham, are given below:

ASPHALT BLOCK

The asphalt block from Houston to Third Street was made of asphaltic cement, crushed trap rock and inorganic stone dust. The specific gravity was not less than 2.45 and, after drying for 24 hr. at a temperature of 150 deg. F., no greater absorption than 1 per cent of moisture when immersed in water for 7 days was allowed. The blocks were 5 in. wide, 3 in. deep and 12 in. long. They were laid on a 5½-in. concrete foundation over which had been spread a ½-in. mortar cushion. The pavement was opened to traffic in November, 1912. The work was done by the Harlem Contracting Company.

The joints are indiscernible except at recent restorations. The general appearance of the pavement is fair, but it is pitted over almost the entire area. Cracks, evidence of wear, appear along the car rails extending outward about 18 in. or 2 ft.

MEDINA SANDSTONE CUBES

The Medina sandstone cubes from Third to Fourth Street were 3½ in. in dimension. They were laid on a 6-in. concrete foundation over which had been spread a ¼-in. sand cushion. The tight joints were filled with Portland cement grout. The pavement was opened to traffic in January, 1913. The work was done by the Franklin Contracting Company.

This pavement is undulating under traffic. Large cracks have developed in the joints and small cracks in the heads of the cubes. About 10 ft. of the blocks have been cracked or sunk under traffic. There are indications of extensive repairs having been made during the past year.

REGULAR MEDINA SANDSTONE BLOCKS

The Medina blocks from Fourth to Fifth Street were 3½ to 5½ in. thick, 6 to 6½ in. deep, and 7 to 12 in. long. The stones were so cut that they had parallel sides and ends; they were laid with close joints on a 1½-in. dry sand cushion over a 6-in. concrete foundation. The joints were filled with grout. The pavement was opened to traffic in January, 1913. The work was done by the Franklin Contracting Company.

The surface of this pavement is very rough and uneven. Some of the blocks have broken under traffic. Others are sunk and depressed. In general, this type of pavement has given poorer service than any other type of pavement within the experimental limits.

SOUTHERN SHORT-LEAF PINE BLOCKS

The blocks from Fifth to Sixth Street were treated with 20 lb. of heavy oil per cubic foot. The specific gravity was not less than 1.10 at 38 deg. C. They were laid on a 6-in. concrete foundation over which had been spread 1 in. of sand. The joints were filled with fine sand and the pavement was thoroughly rolled. The pavement was opened to traffic in January, 1913. The work was done by the United States Wood Preserving Company.

The south side of Sixth Street to halfway between Sixth and Seventh Streets was laid with short-leaf pine blocks, treated with 20 lb. of light oil per cubic foot. The specific gravity was not less than 1.03 nor more than 1.08 at 38 deg. C. These blocks were laid in a similar manner and on the same foundation as described for the blocks between Fifth and Sixth Streets. The roadway was opened to traffic in January, 1913. The work was done by the United States Wood Preserving Company. From the end of this section to the north side of Seventh Street the blocks were treated with 20 lb. of water-gas tar per cubic foot.

On close examination this pavement presents a slight undulating appearance. It is otherwise in excellent condition. Large cross annular rings in the wood are now plainly discernible, most probably indicating that the bleeding period is over.

SHEET ASPHALT ON COMMON BINDER

The asphalt pavement from Seventh to Ninth Street consisted of a 2-in. wearing coat over a common binder 1 in. thick. It was laid on a 6-in. concrete foundation. It was opened to traffic in November, 1912. The work was done by the Sicilian Asphalt Paving Company.

This pavement is slightly rolling in appearance, but otherwise in good condition. No restorations due to wear and tear have been made in this stretch of pavement during the past year.

ROCK ASPHALT BLOCKS

The rock asphalt blocks from Ninth to Eleventh Street were made of natural bituminous limestone rock. They were 2 1/3 in. deep, 8¼ in. long, and 4 in. wide; the minimum weight per block was 6 lb. They were laid on a ½-in. mortar bed spread over a 5½-in. concrete foundation. The roadway was opened to traffic in October, 1912. The work was done by the Sicilian Asphalt Paving Company.

The blocks have rolled together so that the joints are not discernible. The surface resembles sheet asphalt pavement and is in fair condition.

SHEET ASPHALT ON CLOSE BINDER

The sheet asphalt pavement on close binder from Eleventh to Thirteenth Street consisted of a 1½-in. asphalt wearing surface laid on a close binder course 1½ in. in thickness. It was laid on a 6-in. concrete foundation. The pavement was opened to traffic in November, 1912. The work was done by the Sicilian Asphalt Paving Company.

With the exception of some slight defects along the curb and at the car rail, this pavement is in good condition.

SOUTHERN LONG-LEAF YELLOW PINE BLOCKS

The Southern long-leaf yellow pine blocks from Thirteenth to Fifteenth Street were 4 in. deep, 3 in. wide, and 8 in. long. They were laid on a 1-in. sand cushion over a 6-in. concrete foundation. From the south side of Thirteenth to the north side of Thirteenth Street the blocks were treated with 16 lb. of heavy oil per cubic foot. The specific gravity was not less than 1.10 at 38 deg. C. From the north side of Thirteenth Street to halfway between Thirteenth and Fourteenth Streets the blocks were treated with 20 lb. of heavy oil per cubic foot. The specific gravity was not less than 1.10 at 38 deg. C.

Half way between Thirteenth and Fourteenth Streets to the south side of Fourteenth Street the blocks were treated with 20 lb. of light oil per cubic foot. The specific gravity was not less than 1.03 nor more than 1.08 at 38 deg. C.

From the south side of Fourteenth Street to the north side of Fourteenth Street the blocks were treated with 16 lb. of light oil per cubic foot. The specific gravity was not less than 1.03 nor more than 1.08 at 38 deg. C.

From the north side of Fourteenth Street to halfway between Fourteenth and Fifteenth Streets the blocks were treated with 20 lb. of water-gas tar per cubic foot with a specific gravity not less than 1.10 at 38 deg. C.

From half way between Fourteenth and Fifteenth Streets to the south side of Fifteenth Street the blocks were treated with 16 lb. of water-gas tar per cubic foot with specific gravity not less than 1.10 at 38 deg. C. The roadway was opened to traffic in October, 1912. The work was done by the United States Wood Preserving Company.

There is nothing in the present appearance of this stretch of pavement to indicate that the blocks contained in certain portions of this area had received different kinds of treatment. It is in very good condition.

ASPHALT BLOCK

The asphalt blocks from Fifteenth to Seventeenth Street were made of asphaltic cement, crushed trap rock and inorganic stone dust. The specific gravity was not less than 2.46. After drying for 24 hr. at a temperature of 150 deg. F. they showed no greater absorption than 0.6 per cent of moisture when immersed in water for seven days. The blocks were 5 in. wide, 3 in. deep, and 12 in. long; they were laid on a 5½-in. concrete foundation over which had been spread a ½-in. mortar bed. The joints were filled with fine sand. The roadway was opened to traffic in November, 1912. The work was done by the Harlem Contracting Company.

The general appearance of this pavement is fair. The joints have rolled together and the whole presents an even appearance. There is evidence of considerable restoration having been made during the past year. At several points in this stretch, particularly at the east intersection of Fifteenth Street, the pavement is very much pitted.

WOOD BLOCK

At the Seventeenth Street intersection Australian tallowood block was laid. These were painted with tar before laying. They were 4½ in. deep, 3 in. wide, and 8¾ in. long; they were laid on a ½-in. tar cushion. The joints were as close as possible and were filled with paving pitch. Adjoining the Australian wood block pavement to the north side of Ninetenth Street southern short-leaf pine blocks were laid. The blocks were 4 in. deep, 3 in. wide, and 8 in. long; they were laid on a 1-in. sand cushion over a 6-in. concrete foundation and the joints were filled with fine sand.

From the north end of Seventeenth Street to the south side of Eighteenth Street the blocks were treated with 16 in. of heavy oil per cubic foot; the specific gravity was not less than 1.10 at 38 deg. C.

From the south side of Eighteenth to the north side of Eighteenth Street the blocks were treated with 16 lb. of light oil per cubic foot; the specific gravity was not less than 1.03 nor more than 1.08 at 38 deg. C.

From the north side of Eighteenth to the north side of Nineteenth Street the blocks were treated with 16 lb. of water-gas tar per cubic foot; specific gravity not less than 1.10 at 38 deg. C. The roadway was opened to traffic in October, 1912. The work was done by the United States Wood Preserving Company.

At the intersection of Seventeenth Street the Australian tallowood block pavement has failed decidedly. There is very little of the original pavement remaining. That which remains is bulged, cracked and distorted.

The pine block pavement from the north side of Seventeenth Street to the north side of Nineteenth Street is in very good condition.

SHEET ROCK ASPHALT

The sheet rock asphalt pavement from Nineteenth to Twenty-first Street is made of asphalt obtained from the Sicilian rock asphalt mines at Ragusa, Sicily. The asphalt was 2½ in. thick and laid on a 6-in. concrete foundation; the roadway was opened to traffic in September, 1912. The work was done by the Sicilian Asphalt Paving Company.

This pavement presents a fairly good appearance, but close examination discloses the fact that a considerable part of the area has been restored. As a matter of fact, this pavement has shown more defects due to wear and tear than any other smooth type of pavement within the experimental limits.

GROUTED GRANITE BLOCK

The granite blocks from Twenty-first to Twenty-third Street were from 7 in. to 11 in. long, 3½ in. to 4½ in. wide, and 5 in. deep. The blocks were laid with joints not exceeding ¾ in. on a ¾-in. sand cushion over a 6-in. concrete foundation. Dry sand was broomed into the joints to within 3 in. from the top. Portland cement grout was poured into the joints until they were flush with the top of the blocks. The roadway was opened to traffic in June, 1912. The work was done by Thomas Tarpy, contractor.

This pavement is in fair condition. The joints are cracking larger, particularly those parallel to the line of traffic. The surface of the blocks is rounding and the cement grout has entirely worn off the top.

Well Pump Inefficiencies Due to Varying Water Levels

Necessity of Knowing the Pumping Level and the Variations Expected Are of Vital Importance in Obtaining Efficiency

BEFORE buying a well pump it is of the utmost importance to know the pumping level, and to obtain a knowledge of the behavior of other wells in the territory so as to estimate the probable changes which may be expected in the future, according to Douglas A. Graham in a paper recently presented to the Illinois Society of Engineers and Surveyors. In explaining how different classes of pumps are affected Mr. Graham said that in the air-lift pump the efficiency is largely dependent on securing the proper submergence of the air pipe. This should be about 60 per cent for best results. In installing an air lift an estimate may be made in advance and the pipe readily raised or lowered after the tests are made until the desired point is reached. After the erector leaves, however, there is small chance for the adjustment of the air pipe by the station employees. They seldom have the necessary knowledge and it is rare that convenient means for measuring the pumping level are provided. Practically all well levels change with time and some very rapidly, one instance of a drop of 70 ft. in one week being known to the writer. If a water level 100 ft. below the surface should drop to 120 ft., the air pipe, which has been 250 ft. below the surface, would have to be lowered 50 ft. If this were not done, the submergence would drop from 60 to 50 per cent, with a corresponding material loss of efficiency. The air lift, therefore, while easily adjusted within reasonable limits, is materially affected by changes in the water level and it is probable that few of these plants maintain their best efficiencies very long after they are installed. Many tests of old air-lift plants show efficiencies as low as 10 per cent over all, while the manufacturers' guarantees now run to 30 and 40 per cent. This is due partly to changing water levels and partly to various improvements in design.

The plunger pump also is affected materially by the original pumping level and its variations, although its reliability changes more than its efficiency. The rods, pump head and motive power must be designed for given loads. As long as the water level remains above the working barrel all goes well, as the entire machine is usually designed for a head equal to the depth the plungers are placed below the surface plus a constant surface pressure. If, however, the water level drops below or close to the barrel, trouble is sure to begin. The pump will take air, and breakage and loss of efficiency result. If the condition of the well permits, the barrel may be lowered, but the strain on all parts is thereby increased and trouble is likely to occur. Plunger pumps are not suitable for changing well conditions and should be specified only on thoroughly proved data.

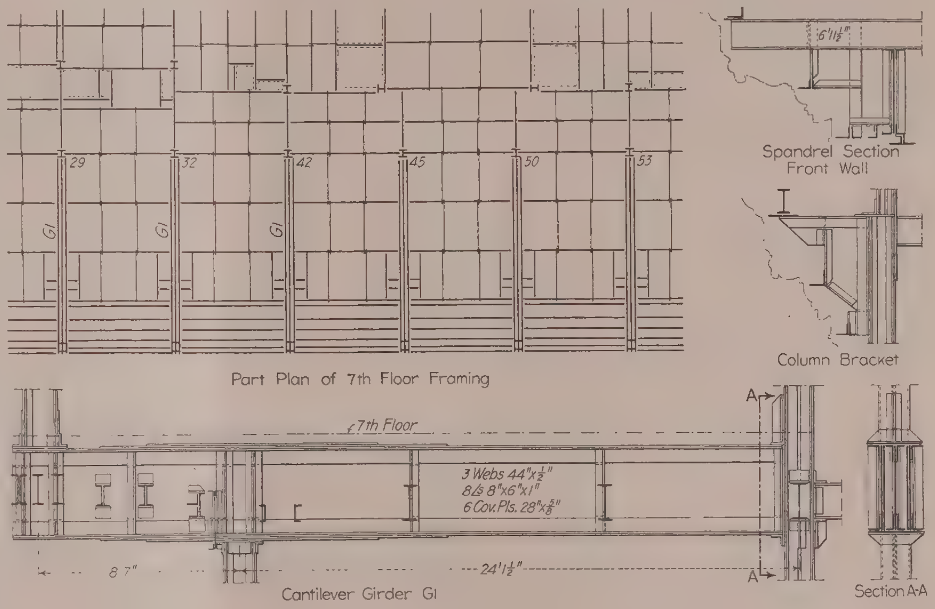
The turbine pump has the same limitations as the plunger pump with an important addition. The efficiency and capacity of a turbine are only at a maximum for a very short range of head fluctuation and fall off very rapidly as the head increases. It is absolutely essential that a pump of this class be designed for a definite and known water level, and a change in this level frequently requires the reconstruction of the entire pump. There are some forms of rotary propeller pump which do not have this objection as they are built in sections and can be extended within the limits of strength and of motive power.

THE PALACE OF MACHINERY at the Panama-Pacific Exposition has a total floor space of 245,000 sq. ft. All of this has been assigned to exhibitors and the average space occupied by exhibits is 1000 sq. ft.

Structural Features of Northwestern-Mutual Life Insurance Building, Milwaukee

Second-Floor System of Plate Girders and Supports for Heavy Marble Ceiling and Massive Columns—Very Heavy Girders With Triple Webs

THE 240 x 188-ft. eight-story building in Milwaukee for the home office of the Northwestern-Mutual Life Insurance Company is a steel cage building with a heavy framework that is not unusual in construction except at the second, seventh and eighth floors. At the second and seventh floors a number of columns are offset from their lower-story sections and are supported on very heavy plate girders, some of them having triple webs and some of them being cantilevers with long overhangs. The second-floor framing also provides heavy beam-and-girder platforms for the support of a facade of ten solid stone columns 7 ft. in diameter and five stories high. This facade reaches across the entire front of the building. Special construction is also provided for the support of the deep terra cotta cornices at the second and eighth floor levels. A large part of the first-story ceiling consists of thick marble slabs supported from the second-floor beams and girders on a suspended framework of horizontal angles and channels.



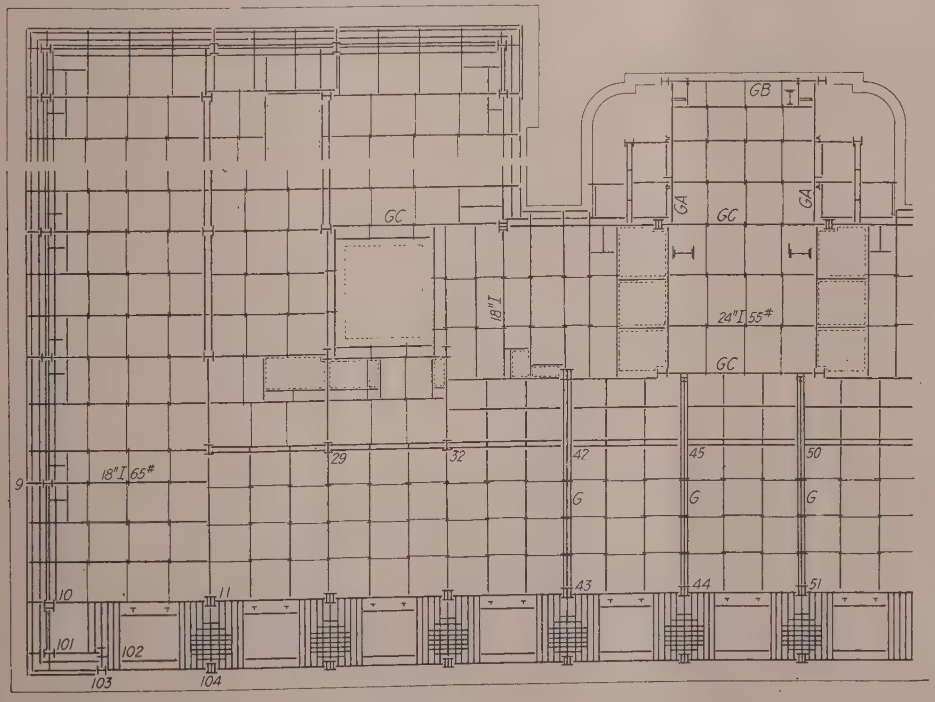
PLAN OF SEVENTH FLOOR AND DETAILS OF THREE-WEB GIRDERS

SECOND-FLOOR GIRDERS

The location of columns, which are generally spaced from 8 to 27½ ft. apart, together with the arrangement of girders and the position of the stone columns in the front of the building, are indicated on the diagram of part of the second-floor framing. The framing is symmetrical about the center line. All plate girders are marked G, GA, GB or GC, and all other beams and girders are rolled I-beams. These are in general 18 in. deep, but for long spans and heavy loads, there are some 24 in. deep with reinforced flanges, and there are also a few lighter beams for short spans and for the column grillages and wall piers.

The triple-web girders G each carry one five-story column of the row in the line 42-45-50, thus providing for economical floor construction from the second to the seventh story.

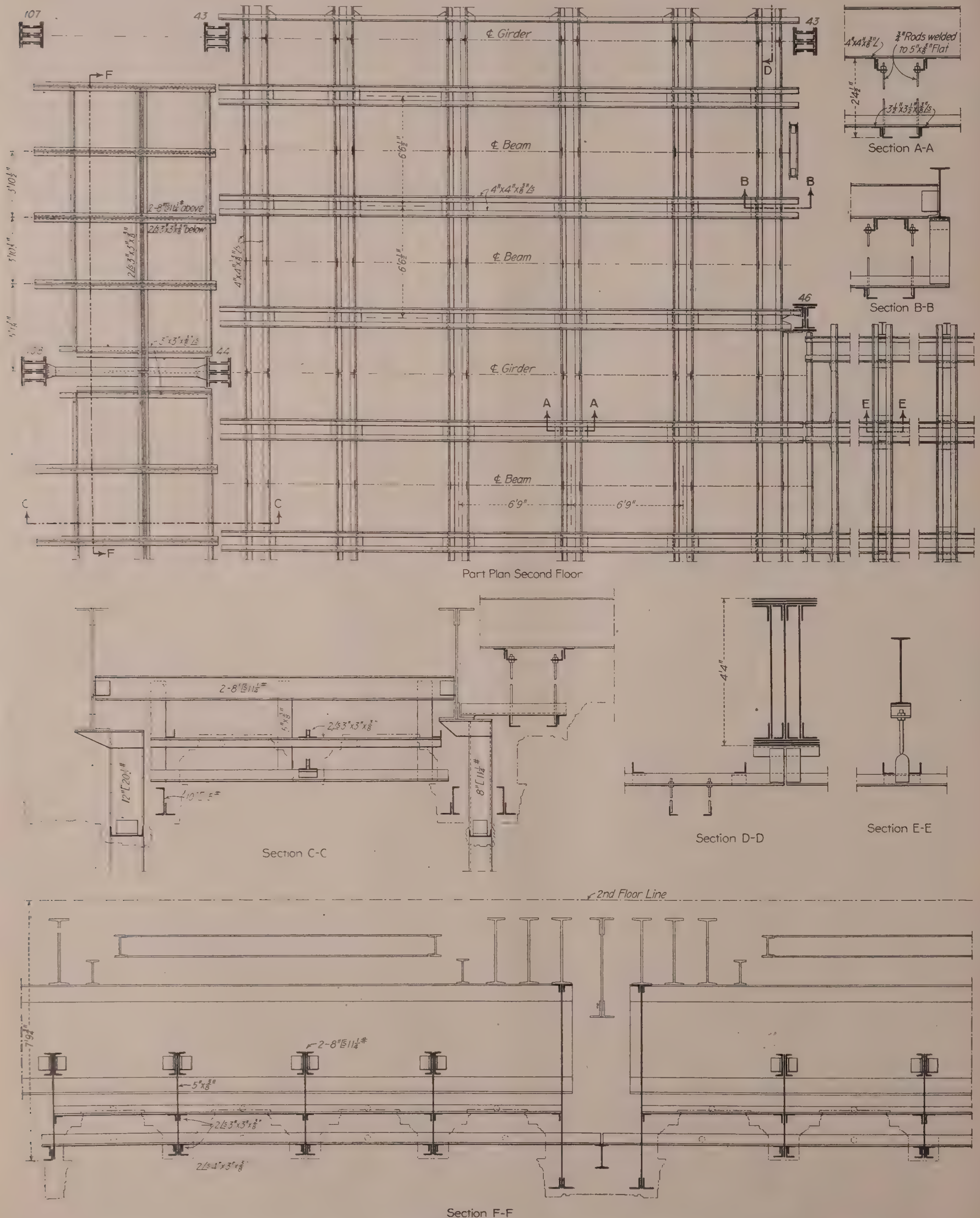
The girders GA carry a part of the second floor and also support the upper-story columns, which are 4 ft. from one end, as shown in the elevation. They are of a design which amounts substantially to the combination of a long girder with a web 59 in. deep and a short girder with a web 31 in. deep, spliced together end to end by web cover plates and by the extension of the flange angles of the shallow girders, which are riveted to the web of the deep girder. At the 31-in. end the girder is supported by hitch angles riveted to the web of another girder, and at the 59-in. end



FRAMING PLAN OF SECOND FLOOR WITH LOCATION OF GIRDERS AND COLUMNS the bottom flanges are seated on the top flange of girder GB.

Girder GB carries a moderate floor and wall load and a heavy concentrated load from girder GA very near its end supports where it is heavily reinforced. It is connected to the columns by field rivets through its web splices and through a projecting gusset plate made integral with the column web and extending below the bottom flanges of the girder.

The stone columns at the front terminate at the seventh floor, which is carried over their tops and, together with the cornice, is supported on the overhangs of triple-web cantilever girders G1 in the planes of the second-floor girders G. The latter are fulcrumed on columns 43, 44 and 51 and anchored to their rear columns 32, 42 and 45. These girders have lower flange bearings on the tops of the fulcrum col-



PART PLAN OF SECOND FLOOR GIVING LOCATION OF GIRDERS AND COLUMNS WITH DETAILS OF CEILING SUPPORTS umns, and the ends of the long arm are field-riveted through the vertical web-stiffener angles to extended cover plates on the faces of the interior columns to which they are anchored. Additional anchorage reaction is provided by vertical distribution angles riveted to the faces of the interior columns with their lower ends bearing on the top flanges of the girders.

SUPPORT OF FACE COLUMNS AT FIRST FLOOR LEVEL

The construction of the platforms to carry the loads of the five-story stone columns is illustrated by the plan and section of a typical platform between structural columns 11 and 104. The principal girders have special end sections, the webs of which project below their bottom flanges to form gusset plates or kneebraces and are field-riveted to the columns through hitch angles. The platforms are grillages of 12-in. I-beams embedded in concrete and supported on 24-in. I-beam girders with their webs reinforced by vertical angle stiffeners with the ends ground to bear on the flanges. The concrete is reinforced by crossed tiers of rods under the column bases.

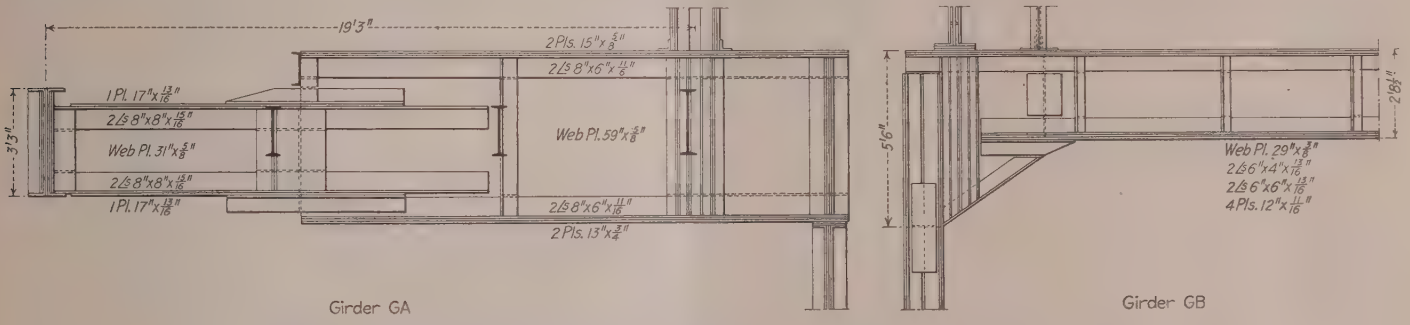
The I-beam wall girders are seated on the top flanges of heavy rectangular solid-web brackets field-riveted through hitch angles to the faces and webs of the columns. The cornice or molding is supported from a special beam made of a channel with an angle riveted to the top of the web, and carried by shelf angles projecting beyond the bracket webs to engage the top and bottom flanges of the channel.

CEILING SUPPORTS

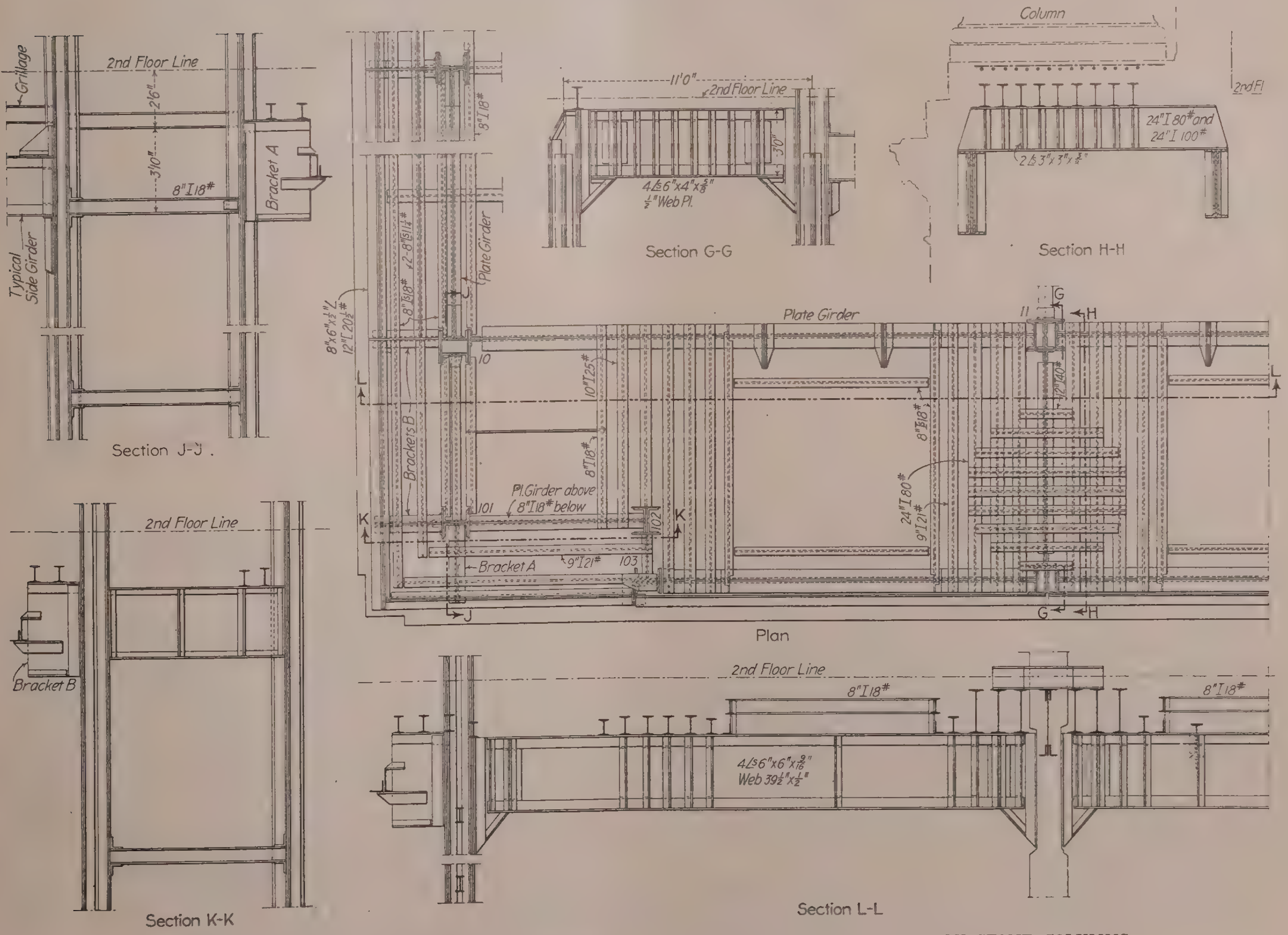
The heavy marble slabs in the first-story ceiling are carried by a framework of pairs of longitudinal and transverse angles suspended from I-beams supported by the main girders and forming panels from about 3 ft. to 7 ft. square. The marble slabs, not shown in the drawing, are bolted to horizontal flanges of pairs of 3 x 3-in. angles with their vertical flanges turned upward. These angles are suspended by vertical plates riveted to their vertical flanges and angle clips on the bottom flanges of the beams and girders, and by flat plates riveted to them and welded to screw rods with nuts engaging the bottom flanges of Z-shaped connections made of two short angles riveted together through their vertical webs and riveted to the bottom flanges of the beam above. The heavy ceiling ribs are carried with riveted connections securing a considerable degree of stiffness.

Marshall & Fox, of Chicago, were the architects of the building.

AUTOMATIC GAGES, run by electricity, will record the fluctuating heights of water of an artificial river in the exhibit maintained by the U. S. Geological Survey at the Panama-Pacific Exposition.



DETAILS OF GIRDERS GA AND GB—FOR LOCATION SEE FRAMING PLAN OF SECOND FLOOR



PLAN AND DETAILS OF FRAMING OF PLATFORMS FOR CARRYING LOADS OF FIVE-STORY STONE COLUMNS

New Indianapolis Pumping Station Designed for Continuous Service

Steam Plant of 18,000,000-Gallon Daily Capacity and Reservoir, Compactly Arranged to Supersede Electrical Boosting Pumps

During 1914 a new 18,000,000-gal. pumping station, a 1,500,000-gal. reservoir and deep well system were completed in Indianapolis, to care for the entire eastern section of the city, including Brightwood, Brookside Park, Irvington, Tuxedo and Beech Grove. The district lies approximately 100 ft. above the business section and has been served by an electrical booster station at Michigan and Rural Streets. Of special interest is the compact arrangement of pumping station and reservoir which was described in a committee report on waterworks at the recent meeting of the Indiana Engineering Society.

The pumping units are located immediately between the reservoir and the boiler plant, giving a short and simple arrangement of suction and steam lines. The reservoir wall forms the west basement wall of the station building, the top elevation being 3 ft. above the engine room floor, which gives a positive suction on all of the pumps at all times with a full reservoir. This wall is faced with brick to conform with the interior of the engine room. As a whole, the station is designed to give maximum results with a minimum expenditure of labor and material, taking into account the necessity of uninterrupted service.

Station Building

The station building is of classic design, constructed of hydraulic pressed brick with Bedford stone trimmings. It is 106 ft. long, 67 ft. wide and rises 40 ft. above the ground. The basement walls are of solid concrete without window openings, and the top is high enough so that the operation of the station may not be interrupted at times of high water. The entire building is fireproof throughout; the roof is of reinforced concrete, carried on steel trusses and columns. The pumping equipment consists of one DeLaval steam turbine pumping unit having a daily capacity of 6,000,000 gal. when pumping against the high service pressure of 150 lb. per square inch, and double this amount when pumping against the ordinary pressure of 75 lb. per square inch; also, one Allis-Chalmers horizontal cross compound pumping engine of the opposed type, having a capacity of 6,000,000 gal. daily when pumping against high service.

Provision has been made in this room for the installation of additional pumping engines to the extent of 30,000,000 gal. daily capacity. The boiler equipment consists of Babcock & Wilcox boilers provided with Laclede-Christy chain grates and mechanical means for handling both coal and ash. The coal is delivered to the plant over an elevated railway structure of reinforced concrete and steel arranged so that the coal drops directly into the coal pockets without manual labor of any kind. The steam lines are arranged in duplicate, with loops and bends and cast-steel valves and fittings furnished entirely by Crane Company and built to withstand a working steam pressure of 250 lb. per square inch.

The chimney for this station is built of radial brick of a color consistent with the exterior of the other buildings, and was furnished by the M. H. Kellogg Company, of New York. It is 14 ft. in diameter at the base and rises 180 ft. above the foundation. It has a special fire brick lining for 50 ft. above the foundation and is connected with the boiler settings by a reinforced concrete breeching flue.

The reservoir is of reinforced-concrete design, 135 ft. long, 110 ft. wide and 15 ft. deep. The roof is formed by a series of groined arches supported in four directions on large concrete columns. The floor is formed by reinforced inverted groined arches designed to balance external pressure at times when the reservoir may be empty. Provision has been made in this design for a filtration plant to be located directly above the reservoir, the load of which will be carried on the concrete columns. Ground has been purchased for a large sedimentation basin to be used in connection with the proposed filtration plant. The present reservoir is covered with earth to keep the water cool in summer and from freezing in winter.

The source of supply is from deep rock wells averaging about 320 ft. in depth. The tests show this water to be extremely satisfactory for both domestic and industrial uses. The water is raised by electrically-driven DeLaval pumps of special design, and deliver the water through cast-iron supply mains into the covered reservoir adjacent to the station. Venturi meters of the Simplex type have been installed for measuring both the well supply and the delivery from the main pumping units.

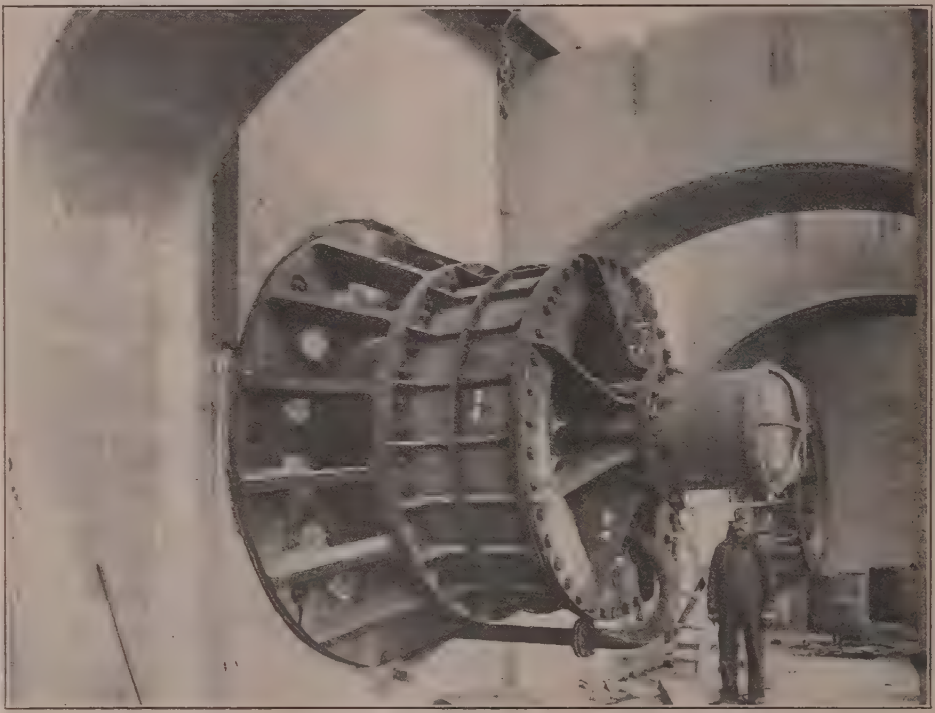
The transmission main leading out of this station is 24-in. extra heavy cast-iron pipe, laid in duplicate through the station grounds. It connects with the 20-in. cast-iron pipe in Brightwood, continues a distance of 7 mi. through the territory which it serves, and terminates at the Big Four shops at Beech Grove.

The engineering and construction work of the Indianapolis Water Company is carried on by its own staff of engineers and construction force under the immediate direction of C. H. Hurd, vice-president and chief engineer.

Install Huge Balanced Valves at Arrowrock Dam

Twenty-two 58-in. diameter, semi-steel and bronze balanced valves, weighing 42,000 lb. each, are being installed on the upstream side of the Arrowrock dam on the Boise irrigation project in Idaho. They are hydraulically balanced needle-valves, each consisting of a cylindrical semi-steel structure having a circumferential inlet and a central discharge. Within the cylinder, which is closed at the outer end, slides a piston, the inner end of which forms a needle operating to regulate the amount of water discharged and closing similar to a check valve.

The valves are installed with their axes in horizontal planes and will be submerged in the reservoir. They are set in two tiers. The lower valves will be under approximately 200 ft. maximum head and the upper ones under about 100 ft. The accompanying photograph shows one of these valves in place. The concrete arches form the valve chamber and its top will be covered with a rack. The design of these valves was published in the Engineering Record of July 11, 1914, page 53.



SCREEN CHAMBER WITH LARGE HYDRAULICALLY-BALANCED NEEDLE VALVES

The dam is built by the U. S. Reclamation Service. F. E. Weymouth is supervising engineer of the Idaho Division and C. H. Paul, construction engineer of the Arrowrock Dam. The manufacturer of the valves is the Joshua Hendy Iron Works, San Francisco, Cal.

The Cost of the Stockton Street Tunnel in San Francisco has recently been announced by M. M. O'Shaughnessy, city engineer. The total cost is given as $621,000, of which $430,000 represents the actual construction and $191,000 the damages paid property owners. The length of the tunnel between portals is 911 ft. and approach cuts are 138 and 275 ft. long respectively. The total yardage excavated was 43,500, and 16,500 cu. yd. of concrete were used, containing 637,000 lb. of steel reinforcing.

Build Brick Road on Machine-Leveled Subgrade

Industrial Equipment, Specially Designed Road Roller and Labor Organization Are Features of Work in Ohio

INDUSTRIAL equipment for hauling material and the use of a specially designed sub-grade leveling machine are features of the 9.7-mi. road between Alliance and Louisville, Ohio, one of the longest sections of brick construction in the State. The road is being built 15 ft. wide, with a 6-in. slag foundation on which is laid a 2-in. granulated slag cushion for wire-cut-lug paving blocks. Longitudinal expansion joints are placed along the concrete curbs which flank the road.

To date 5.2 mi. of the road have been completed. The remaining 4.5 mi., for which all heavy grading is finished, will be built this spring as soon as weather conditions permit. The road as constructed is of the general type built in that section of the country, a paved roadway on the right-hand side leading to market with a 10-ft. dirt road on the opposite side in order to facilitate the suburban traffic. The width of the beam on the brick side of the road is 3 ft. Ditches are located on each side affording ample drainage for both the brick and dirt roads. The grades are in general very light, except for a short stretch where the maximum is 4 per cent. Heavy grading was done with a ⅝-yd. Thew steam shovel and dump cars. For the lighter grading a New Era elevating grader and dump wagons were used.

SLAG BASE

The grading was carried forward a considerable distance in order to keep ahead of the sub-grade party that followed, after which the concrete curbs were placed for a distance of 2½ mi. Following the concrete curb crew came the special sub-grade leveling machine which brought the sub-grade to the proper elevation and contour. The sub-grade was then rolled by a 10-ton Russell steam-roller, and a layer of crushed slag, the largest pieces not exceeding 4 in., was deposited to a depth of 8 in. and rolled to a finished foundation not less than 6 in. in depth. The foundation was prepared between 1 and 1½ mi. ahead of the completed road. On the slag base a 2-in. cushion of granulated slag was deposited and rolled by the 10-ton roller. Additional slag, scattered over the rolled surface, was struck off with a templet in order to bring the finished surface to the required contour of the roadway. On the slag cushion the paving bricks were laid, culled and then rolled with a 5-ton roller to a smooth surface. The grout prepared in a Standard mixer consisted of 1 part cement and 2 parts cleaned, washed sand.

The water used for all work along the road was delivered through pipe lines 1, 1¼, 1½ and 2 in. in diameter, laid on the outside of the improvement, and was pumped by a Domestic direct-connected gasoline pump. After the wooden strips adjacent to the curb were removed the grout was raked off of the recess and tar poured in to form an expansion joint.

The grouting was covered with ½ in. of sand and earth in order to protect it from drying and setting too fast. The roadway was then barricaded for a period of 21 days, after which the pavement was cleaned off and the road thrown open to traffic. Then the dirt road and berm were graded to the proper form and width and side ditches were constructed to a depth of 14 to 16 in.

SUBGRADE LEVELING MACHINE

The two rear wheels of this machine run on the curb. A roller is fastened on the end of the leveler in order to keep the blade from shearing the curb. The blade can be raised to clear the curb or lowered to cut 14 in. below it, and it can be swung by a bevel cog gear so as to carry excavated material either to the right or to the left curb. In front of the blade a digger is hung to cut the high spots in order that the leveler can operate in hard ground. The machine is drawn by a Russell general utility engine.

HAULING METHODS

All material was delivered along the work in 1½-yd. Western dump cars, hauled by an 8-ton, 24-in. gage Vulcan locomotive on track constructed ahead of the work on one side of the road using 30-lb. rails and wood ties. The slag was unloaded from a trestle chute into the dump cars. By dumping a string of cars twice in the same position, enough material was obtained to bring the base to its proper height.

Unskilled labor consisted of Italians and Roumanians, who took care of their own board and lodging. The skilled laborers were taken care of in shacks of such design as to provide two rooms with a capacity of four men to a room. There were in all six shacks, including cook house and dining room. The office of the contracting company was located with the camp at Louisville, Ohio.

The Wm. H. Vogt & Sons Company, of Massillon, Ohio, are the contractors for the work, which is under the supervision of W. Lee Bender, county engineer, with Paul Chevreaux as inspector.

SPECIAL SUBGRADE LEVELING MACHINE

GANG UNLOADING AND LAYING BRICK

Only Creosote Properly Applied Withstands Teredo

Plenty of Standard Quality of Oil Must Be Used to Protect Piles Against Marine Borers—Importance of Naphthalene

PLENTY of oil of standard quality must be injected into the piles if creosoting is to protect them in waters infested by the teredo, according to a paper presented at the recent convention of the American Wood Preservers' Association by E. S. Christian. Mr. Christian stated that in thirty-two years' experience with creosoted timber he had known of many instances where the treatment had failed to protect the timber from the teredo and its class, but that in every instance the failure could be traced, either to ignorance on the part of the engineer in not specifying sufficient oil, or to knavery on the part of the creosoting plant in not complying with the specifications.

In this paper, Mr. Christian emphasized the importance of the naphthalene fraction for marine work. He told of the success of creosoting on the piles of pier 6 of the Chesapeake & Ohio Railway at Newport News, Va. The pier is 800 ft. long and 200 ft. wide, and required about 4000 piles. It was first built in 1879 on charred pine and cypress piles, the belief at that time being that charring made timber immune from all marine borers. Examination a year later, however, showed that the piles were damaged to such an extent as to make the pier unsafe, and the structure was rebuilt on creosoted piles.

Mr. Christian was inspector at the creosoting plant, and his instructions were to see that every cubic foot of each of the 4000 piles absorbed 12 lb. of oil. One of the tests to determine this was to bore each pile in six places and if any boring showed a penetration of less than 1½ in. to have the pile treated again. The oil was bought by the railroad under the following specifi-

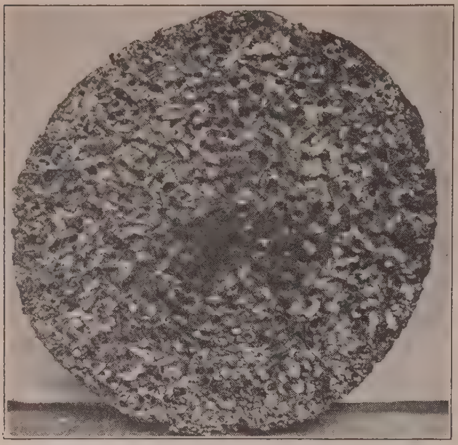


FIG. 1—INEFFECTIVENESS OF CHARRING

cations: It must be distilled from the coal tar derived from Newcastle coal, and must be of a greenish-yellow color when liquefied; it must not contain any water; it must not contain more than 8 per cent of tar acids, nor less than 60 per cent of naphthalene, nor less than 20 per cent of anthracene and anthracene oil; not less than 5 per cent must remain in the flash after it had been heated to a temperature of 320 deg. C.

What the Illustrations Show

Fig. 1, taken from Mr. Christian's paper, shows a cross-section of one of the original charred piles. Fig. 2 shows two pieces of the same piles on the bottom row, and, immediately above, two pieces of a creosoted 80-ft. pile taken from the pier in 1912. Three other sections of this same pile were sent to as many chemists to determine the quantity and which fractions of the oil remained. It was found that after thirty years' service there remained 10½ lb. of the original 12 lb. of oil, and of this quantity 55 per cent was naphthalene. All of the pieces were taken from that part of the pile between the high water mark and the ground line.

Owing to the difficulty of obtaining oil with more than 35 per cent of naphthalene Mr. Christian is now recommending 16 lb. of oil per cubic foot for marine work in Hampton Roads. He believes, however, that in the treatment of crossties and bridge timbers the naphthalene fraction may be lowered, provided the percentage of pitch is increased.

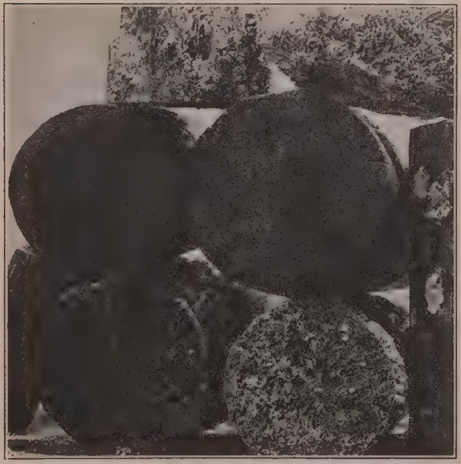


FIG. 2—WHAT PROPER CREOSOTING WILL DO

The two bottom pieces are from the same charred pile shown in Fig. 1. The two immediately above were from a creosoted pile removed after 30 years of service.

Literature

For the Civil Engineer and Contractor

New Publications

Structural Steel Drafting and Elementary Design. By Charles D. Conklin, Jr. Cloth, 8 x 11 in.; 154 pages; well illustrated. New York and London, John Wiley & Sons, Inc. $2.50 net.

Statistics of Common Carriers. Interstate Commerce Commission. Division of Statistics. Preliminary abstracts of report for the year ended June 30, 1914. Paper, 9 x 11½ in.; 187 pages. Washington, D. C., Superintendent of Documents. 25 cents net.

The Creation of Wealth. By J. H. Lockwood. Cloth; 5½ x 8 in.; 225 pages. Cincinnati, the Standard Publishing Company. $1 net.

Universal Safety Standards. By Carl M. Hansen, Consulting Safety Engineer. Compiled under the direction of and approved by the Workmen's Compensation Service Bureau, New York. Leather, 7½ x 5 in.; 312 pages, illustrated. Philadelphia, Universal Safety Standards Publishing Company. $3 net.

A reference book of rules, drawings, tables, formulæ, data and suggestions for the use of architects, engineers, superintendents, foremen, inspectors, mechanics and students. Chapters: General safety standards; machine shop; foundry, and rules for practice.

U. S. Geological Survey—Washington, D. C., Superintendent of Documents. Paper; 6 x 9 in., illustrated.

Thirty-fifth Annual Report of the Director for the Fiscal Year ended June 30, 1914; 163 pages; 2 maps.

Water Supply Paper 330—Surface Water Supply of the United States, 1912; Part X, The Great Basin. By F. F. Henshaw, E. A. Porter and G. C. Stevens; 275 pages; 3 inserts.

Water Supply Paper 335—Geology and Underground Waters of the Southeastern Part of Texas Coasted Plain. By Alexander Deussen; 365 pages, 17 figures; 10 inserts.

Water Supply Paper 345-G—The Water Resources of Butte, Montana. By O. E. Meinzer; pages 79-125; 7 figures; 1 map.

Water Supply Paper 348—Profile Surveys in Hood and Sandy River Basins, Oregon. Prepared under direction of R. B. Marshall; 8 pages; 6 inserts.

Water Supply Paper 366—Profile Surveys of Snoqualmie, Sultan and Skykomish Rivers, Washington. Prepared under direction of R. B. Marshall; 7 pages; 12 inserts.

Bulletin 570—Results of Spirit Leveling in Wisconsin, 1897 to 1913. By R. B. Marshall; 86 pages.

Bulletin 572—Results of Spirit Leveling in Nebraska, 1896 to 1913. By R. B. Marshall; 57 pages.

American Institute of Electrical Engineers, Year Book 1915. Cloth; 6 x 9 in.; 393 pages. New York, American Institute of Electrical Engineers.

Progress of Stream Measurements. Report by Commissioner of Irrigation for the Calendar Year 1913. Department of the Interior, Canada, Irrigation Branch. Paper; 6½ x 9¾ in.; 414 pages; illustrated.

Books Reviewed

Mechanism of Steam Engines

Author, Walter H. Jones, S. B., Assistant Professor in the Department of Mechanical Engineering, Massachusetts Institute of Technology, and Myron W. Dole, S. B., Instructor in Mechanical Engineering, Massachusetts Institute of Technology. Cloth, 6 x 9 in.; 170 pages; 183 illustrations. New York, John Wiley & Sons, Inc. $2.

This book is an elementary treatise on the kinematics of the steam engine, with no mention of the heat theory or use of the steam tables. There is a brief general chapter on the various types of engines, with a description of the steam-engine indicator and its use. Chapter 2 is devoted to single valve engines and various valves are described with drawings showing the position of the valve at various parts of the stroke. The Zeuner, Bilgram and Reuleux diagrams and the valve ellipse are explained in chapter 3 and frequent use of them is made in sections on slide-valve problems, governing devices for single-valve engines, and riding cutoff valves. Chapter 7 describes various multi-valve engines and chapter 8, various hand-operated reversing gears, such as are found on locomotives and on marine engines. Chapter 9 is a rather brief but good chapter on valve setting and is followed by two chapters on the steam turbine and its valves and governing devices.

The book is well adapted for use between a course in elementary mechanism and courses on steam-engine theory and practice, and although primarily intended for use with students in a technical school, it is an excellent book for the operating engineer who wishes to become familiar with valve diagrams, and it has many practical points that cover questions such as are asked of candidates for first class and second class engineers' licenses.

Construction of Masonry Dams

Author, Chester W. Smith, consulting engineer. Cloth, 6 x 9 in., 279 pages, 68 drawings and 16 inserts with photographs. New York, McGraw-Hill Book Company. $3 net.

The need of a book dealing with details of construction and supervision of masonry dams has led the author, a construction engineer of more than twenty years' experience, to undertake the task of treating these subjects from the point of view of the man in the field. The author's experience as chief engineer in charge of the building of the Wachusett and Roosevelt dams has made him an expert in this class of work—one upon whose judgment great confidence can be placed.

Earthwork, rock excavation, cement, pumping and similar subjects previously adequately treated in textbooks have been omitted, while construction plant and methods, explorations, stream diversion, foundations, masonry, etc., have been dealt with in an extensive and adequate manner. Of special interest is the chapter dealing with probable future methods, and the statement that pudding stones will soon be abandoned in favor of mass concrete, which will both save the cost of equipment required to handle such stones and permit a higher rate of progress, is of interest. The suggestion of placing cableways on a skew instead of parallel to the axis of dam, thus making possible the employment of a greater number of cables, is one that is well worth attention.

Consulting engineers and contractors will appreciate the chapter dealing with estimates of cost and the diagrams giving amounts of masonry, rock and earth excavation per linear foot of dam, based on Wegmann's practical profile No. 2 as modified in the American Civil Engineer's Pocket Book, as well as those of overflow sections. Separate curves deal with the quantity of masonry in aprons and cutoff walls. The chapter contains a 4-page table giving the itemized labor costs of masonry at the Roosevelt dam. A table giving detailed costs of plant, plant erection, repairs, expendable materials, etc., has also been included.

The last chapter contains a partial list of existing dams with descriptions and costs and shows the cross-section of nearly every dam dealt with. The costs given will be of great value to engineers and financiers called upon to make or check estimated costs of masonry dams. The author emphasizes that while labor costs should be used with caution and only after a careful comparison of conditions, the costs of plant are more generally applicable, especially as a possible error in this item is insignificant in the total estimate of the dam.

In treating this extensive subject the author has divided the book into fifteen chapters. The first deals with exploration of the site, and with borings and tests. Chapter 2 describes various types of dam, and their costs. The third chapter contains data on preparing the foundation, and it begins with the final stage of excavation. The following chapter is on masonry construction and includes plant. Chapter 5 is on quarrying, and face work is the subject of the following chapter. Chapters 7 and 8 deal with miscellaneous features, such as concreting in freezing weather, the use of salt, settlement of masonry, uplift pressure, drainage of foundations and masonry, effect of temperature changes, leakage, expansion joints, examples of leakage, ice trust, initial stress and instructions to inspectors. Plant and power, including depreciation of plant and other factors, and source and distribution of power, are dealt with in chapter 9, while chapter 10 gives data on the installation required, and on power consumption. The chapters following treat the assembling of materials, crushing and mixing, transportation of materials, probable future methods, estimates of cost and a partial list of existing dams, together with various data as to their costs.

The book is well written and the treatment given the various subdivisions of the subject is excellent. The workmanship on text and illustrations shows, as usual, the high standards of the publisher.

Installing Efficiency Methods

Author, C. E. Knoeppel. Cloth, 7½ x 10 in., 258 pages, illustrated with numbers, charts and diagrams of blank forms. New York, Engineering Magazine. $3.

Probably there is no book in print which gives so clear an idea of the procedure in installing modern efficient methods in industrial organizations as that of Mr. Knoeppel. There can be no better preparation on the part of a manager, who expects to employ a management specialist to study his plant, than a reading of this book. It will forewarn him as to the difficulty, enable him to grasp readily the proposal that the specialist will make, and, above all, show him how necessary is his sympathy with the work, his hearty co-operation and inflexibility in his determination "to see it through," to make the betterment work succeed. Mr. Knoeppel well says that, while there have been failures due to the engineers who have attempted betterment work, "case after case could be cited that would convict the client of 'contributory negligence.'"

Those who propose to attempt by themselves to install efficiency methods in their plants will also find the book of great value. It will not of itself, however, be sufficient to enable one to assume such a task, for details are not gone into fully. Other works—relating principally to time study and bonus payments—should be studied previous to the attempt to use Mr. Knoeppel's book in practice.

In general Mr. Knoeppel's method follows those of Harrington Emerson, principally in connection with bonus payments, and the standardization of conditions and of operations. He has used the best from many sources, although not adhering in detail to either of the principal schools of "scientific management."

Worthy of special commendation are a form for an "accomplishment report" and an excellent set of rules to be observed by the outside staff installing efficiency methods. The "accomplishment report" gives details as to the betterment on each item undertaken, a most valuable record when skeptical officials are to be convinced, or a summary is to be made of the results obtained. The rules for the staff are so full of common sense that with slight modification and some omissions they might well become guiding rules for any executive, in shop or office, in commercial or industrial lines.

Letters to the Editor

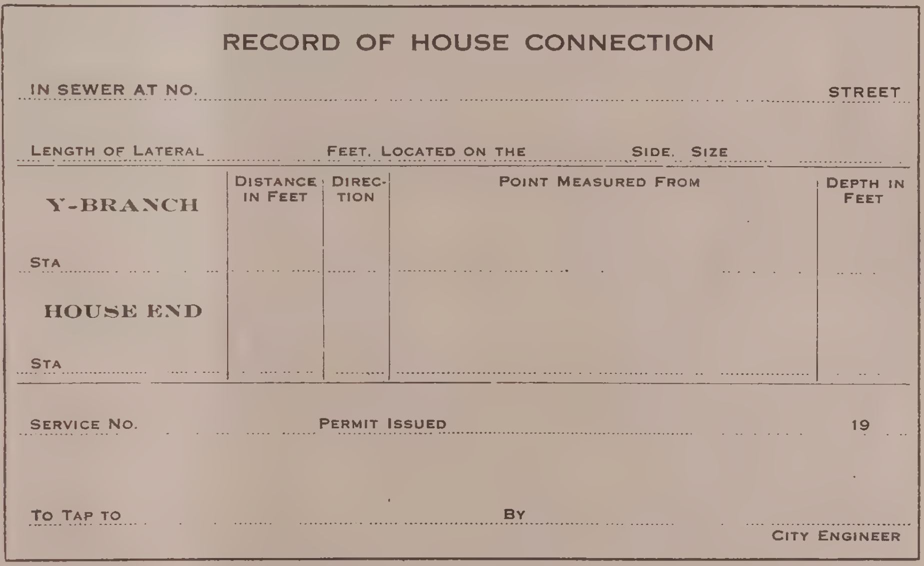
Comment on matters of interest to engineers and contractors will be welcomed

Records of Sewer Service Kept by Card System

SIR: Herewith is a form of sewer service records on the card system which I have devised. I would be pleased to hear from any municipal engineer who has worked anything out on this line.

RAY S. BLINN,
City Engineer.

Mount Vernon, Ohio.



RECORD OF HOUSE CONNECTION

IN SEWER AT NO. .... STREET

LENGTH OF LATERAL .... FEET. LOCATED ON THE .... SIDE. SIZE ....

	DISTANCE IN FEET	DIRECTION	POINT MEASURED FROM	DEPTH IN FEET
Y-BRANCH STA				
HOUSE END STA				

SERVICE NO. .... PERMIT ISSUED .... 19 ..

TO TAP TO .... BY ....
CITY ENGINEER

CARD USED TO RECORD HOUSE CONNECTIONS AT MOUNT VERNON, OHIO

Cost Data for Auto Trucks

SIR: The reported delivery of 400 tons of stone per day by auto truck at a cost of 5.97 cents per ton-mile, commented upon editorially on page 602 of your issue of Dec. 5, 1914, and the article describing the performance on page 621 of the same issue, should not pass without protest. It is purported cost data of such a nature with which contractors so often deceive themselves, and, by their publication, not infrequently delude others. Every contractor experienced in hauling must know that the figure named is an impossible one with the given method, that is, for 5.97 cents per ton-mile to deliver anything whatsoever by auto truck, especially without the use of trailers.

Certain figures and facts given in the article may be accepted as correct, since they are based on actual experience and not assumptions. We would, therefore, believe that each 4-ton truck properly and fully equipped with dump bed and ready for instant service was laid down at the site of the work for the sum of $4000; that actual experience proved that 4.75 cents per mile was the average cost for fuel and lubricants; that drivers were secured for 12-hour shifts for $3, extra drivers for $3.50, and laborers for $2, and that actual experience proved that twenty loads of 4 tons each delivered 4 mi. could be depended on as an average performance for two 12-hour shifts. In the matter of plant charges exception must be taken *in toto* to the figures given.

Concerning the items of interest, depreciation, maintenance and renewal, it is stated that "depreciation, interest and repair charges have been lumped," 20 per cent of the original investment, or $800 per year, being taken as the proper lump amount to cover these items for each truck, and 250 working days of 24 hours each as the probable working time for each year. And it is still further assumed that the record performance of the 54 days included, namely, 160 mi. each day, can be depended on for 250 days in each year. Dividing the working days (250) into this lump sum of $800 gives $3.20, or the amount thus allowed per working day to cover interest, depreciation, maintenance and renewal. This is for a truck making 160 mi. each working day, or 40,000 mi. per year. Let us see what this means.

To put it at a low figure $240, or 6 per cent on the $4000 investment, must be deducted from the lump sum of $800 to cover interest. This leaves $560. And for the moment giving free rein to one's fancy, before making any further deductions from the lump sum of $800, imagine if you can that not one cent is necessary for repairs, renewals or new tires, thus leaving the whole of the $560 remaining for depreciation charges. Dividing $560 into the $4000 item of first cost gives 7.143 years as the required time for the truck to work out its total depreciation. At the estimated rate of 40,000 mi. per year this means the truck must travel 285,720 mi.—truly an extraordinary life of usefulness for a motor truck and one no doubt exceeding even the most sanguine expectations of the auto-truck manufacturer.

The writer professes some small knowledge of the possibilities in auto-truck haul. He believes in the auto truck, but he does not believe the interest of anyone, not even of the auto-truck manufacturer, are subserved by gross misstatements of the auto truck's operations. He would, therefore, from his own experience and judgment reconstruct the above-mentioned purported cost data in somewhat the following manner:

All statements of performances and costs given may be accepted as correct for the particular job except the item of "maintenance and renewal." This item should be broken up into separate parts and some additional expenses not there noted included.

The item of repairs, miscellaneous small items of expense, and renewals (except tire renewals) may best be considered as a variable expense depending on the truck, the driver and the service required. It is measured in miles and severity of service as is the fuel, and may reasonably be expected to vary as that item. In the writer's opinion it should be placed at not less than 65 per cent of the cost for fuel and lubricants. In experiences of others he has seen it shown equal to the expense for fuel and lubricants. But using the more conservative figure based on the writer's own experience at least 3.09 cents per mile would be required in this particular case to cover repairs, miscellaneous small items of expense upon truck and dump body, and renewals exclusive of tire renewals.

Tire renewals should be figured at a fixed cost per mile. The writer's experience has been that 4.58 cents per mile will cover the cost of tires on a 5-ton truck, which is almost 24 per cent cheaper than one would be led to expect from the tire manufacturer's guarantee. One would deduce from this figure of 4.58 cents that approximately 3.50 cents per mile would cover the cost for tires on a 4-ton truck.

The charge for interest, depreciation and insurance (for surely a $4000 investment should carry insurance) depend on some facts and some assumptions. The item of interest is easily determined. The amount named above, that is $240 per year, may be taken as a reasonable amount. Insurance should be secured for approximately $55 per year. Depreciation, depending as it does on use, is more difficult to estimate. Miles, rather than years, measure the life of an auto truck. In the writer's opinion, barring special conditions and special cases, perhaps 100,000 mi. is an ample life to assume under average conditions. And the mileage per year for an ordinary road contractor's truck, again leaving out of consideration trucks purchased for a special freight haul, or any other what might be termed haul on a schedule, should be placed at not to exceed 20,000 mi. This is not to say that this mileage has not been exceeded under specially favorable conditions by double shifting and other expedients. It is merely to say that for the average road contractor having in sight only 54 days of steady haul 20,000 mi. is a fair yearly mileage, and all he can safely plan to depend on. This would give a life of five years to the truck, and it is safe to say that after five years of service, particularly at this stage of motor-truck development and in view of the advances being made in tractor haul, the contractor should plan to have run out the life of his machine. Tire depreciation being figured separately, this leaves approximately $730 as the annual charge for depreciation on truck. Including the $730 for truck depreciation, $240 for interest and $55 for insurance and estimating 20,000 as the yearly mileage would mean a charge of 5.125 cents per mile for interest, insurance and depreciation.

Basing our estimate on these figures we would then reconstruct the purported cost data of the article in question as shown in the following table:

DAILY EXPENSE FOR 1600 TON-MILES

			Cost in cents per ton-mile
Hauling—			
Labor:			
Ten drivers	$30.00		
Extra drivers	3.50		
Four laborers unloading	8.00		
Total		$41.50	2.594
Fuel and lubricants—Five trucks making twenty 8-mi. trips at 4¾ cents per mile		38.00	2.375
Repairs and extras at approximately 3.09 cents per mi		24.72	1.545
Tire renewals at approximately 3.50 cents per mile		28.00	1.750
Interest, insurance and depreciation at approximately 5.125 cents per mile		41.00	2.562
Total for hauling		$173.22	10.826

The figure thus obtained is still a low one for auto-truck haul without the use of trailers. On a job somewhat similar to the one described the writer knows of an instance where a 5-ton truck, working an 8-hour shift, delivering screenings on a State highway with an average haul of 2 mi., averaged twelve loads of 5 tons each per shift. In thirty-eight shifts, without the loss of one hour's time for breakdowns, 2280 tons were delivered, and the resident engineer representing the State, which was renting the truck at a lump sum per shift, expressed himself as well pleased with the truck's performance. The actual cost was 14.30 cents per ton-mile, not including 2.00 cents per ton-mile for the job required to pay for fitting out a special dump bed, the bed being left on hand in good order at the end of the job, but with no immediate prospect of again putting it to use.

With a longer haul the writer knows of instances where a truck has hauled for considerably less than 14.30 cents per ton-mile, and on a longer haul with the use of trailers it is safe to figure on a lower cost per ton-mile.

In a similar manner it could be shown that the plant charges for loading are too low. The delivery, installation and removal of the plant are overlooked, the probable life and percentage of working days for the plant are entirely overestimated, and ample provision is not made for repairs expense.

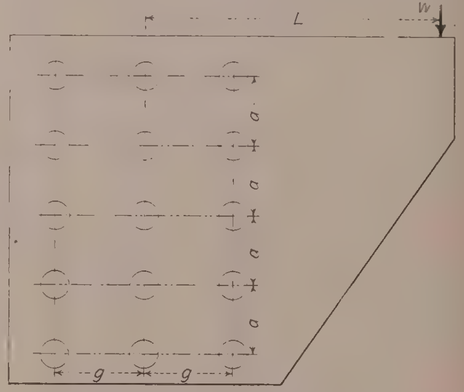
But it is not so much the purpose of the writer to establish what is in his opinion the cost of unloading and delivering gravel. It is rather his purpose to point out some of the frequent causes of faulty cost data and to establish correct principles. Cost data, like dynamite, are very useful tools in proper hands, but their accumulation and use by the inexperienced are fraught with danger. In fact one might almost say in viewing some examples thereof that they should bear the label like dynamite—"Dangerous."

EVERETT N. BRYAN.

Modesto, Cal.

Eccentric Rivet Connections

SIR: Among the letters in your issue of Jan. 9, 1915, appears one on page 58 from Charles D. Conklin on eccentric rivet connections which contains a serious error. The author states that for designing such connections "the method now in common use is long and tedious," but fails to state which is "the method." The writer does not attempt to discover which of several methods in common use the author used in making the diagram shown, but he knows of no rational formula which disregards entirely the rivet spacing in a horizontal direction, as the author does in both his explanation and figures.



A joint similar to the one shown was calculated, using $a = 3$ in. and $g = 9$ in., and also one using $a = 3$ in. and $g = 3$ in., both by the method of taking moments about the center of gravity of the group of resisting rivets and by the method developed by Prof. P. Gullander. (See the Engineering Record of Nov. 7, 1914, page 518.)

The results by the two methods checked fairly closely and indicated that the stress in the farthest rivet of the second joint is approximately 70 per cent more than in the farthest rivet of the first joint. For $g = \infty$ and $L =$ a finite number, the stress due to rotation disappears and the shear on each rivet equals W divided by the number of rivets.

The diagram with the explanation as published is incorrect and misleading.

JOHN C. PRIOR,
Assistant Engineer, Department of Public Service.
Columbus, Ohio.

ANNUAL EXPENDITURES FOR ROAD IMPROVEMENT in the United States amount to about $204,000,000, according to the report of the Joint Congressional Committee on Federal Aid to Good Roads. Automobile licenses bring in $8,000,000 annually. County, township and district road bonds were voted in 1913 to the extent of $50,635,000.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Piles Driven Under Difficulties

IN rebuilding the Union Pacific bridge over the Kaw River at Kansas City nearly half the piles for the new East abutment had to be driven beneath the tracks. After crossing the old double track bridge, the tracks spread out in a classification yard, under the mouth of which the new abutment was located. No driving through the track could be permitted.

The tracks were supported on deck plate girders which spanned the abutment, the steel sheeting worried down in 10-ft. sections, and the excavation finished and braced. The proper number of piles was then lowered through the wood decking and stood up in each pocket. Driving was done with a Monarch steam hammer and swinging leads suspended from the track girders. This hammer is short and required little head-room, but even so many of the 36-ft. piles had to be jetted down several feet before the hammer could ride them. The hammer was handled on a single line leading through various snatch blocks under the tracks to a derrick car located 300 ft. away on a material siding. The leads were handled by raising and shifting them with the hammer, and tying them off with a set of manila rope falls. They were short enough to be moved from pocket to pocket without being taken above the track, and were lowered with the hammer in driving.

Of the 370 piles for this abutment, nearly half were driven in this way, and as the driving was heavy, the hammer light and handling the rig from pocket to pocket slow, the cost of driving was high. It was amply justified however by the fact that the work was done without interrupting traffic.

PILES WERE DRIVEN IN CRAMPED SPACE UNDER MAIN LINE TRACKS

PILES HAD TO BE FED TO DRIVER BETWEEN TRAIN MOVEMENTS

Masonry Placing Records at Three Dams Compared

LAST year the record for rapid placing of concrete and cyclopean masonry was made at the Kensico dam of the Catskill aqueduct, at Valhalla, N. Y., as described on page 199 in this issue. In 1913 the record was 53,240 cu. yd. in one month, while in 1914 it was increased to 84,450 cu. yd. On other works large volumes of masonry also have been placed, and the following figures have been compiled to afford a comparison of the records on the Kensico dam, built by H. S. Kerbaugh, Inc., the Arrowdock dam of the Boise irrigation project in Idaho, built by the U. S. Reclamation Service, and the Elephant Butte dam of the Rio Grande irrigation project in New Mexico. All of these dams have been described previously in the Engineering Record. In the records of 1913, published Feb. 21, 1914, page 215, the Lake Spaulding dam of the Pacific Gas & Electric Company, California, was also included. At this dam, which is being constructed in two installations of which the first was completed in 1913, no masonry has been placed during 1914. Data on the placing of concrete in the three dams mentioned are given in the accompanying table.

At Elephant Butte the total mixer hours worked was 913. As the average number of mixer hours per day was 35.1 and the capacity per batch 1.62 cu. yd. the number of 2-yd. mixer-hours was 28.4. The total number of batches for the month from three mixers was 17,430. The dry loose batch contained 2,452 cu. yd. and the mixed batch 1.62 cu. yd. The number of 2-yd. mixer hours per month was 1.62 x 913/ 2 = 740.

RECORD OF PLACING MASONRY IN LARGE GRAVITY DAMS DURING 1914

	Elephant Butte, Aug.	Arrowrock, June	Kensico, Aug.
Total masonry placed in dam during best month, cu. yd.	34,033	56,520	84,450
Total masonry placed in dam during year, cu. yd.	329,980	359,240	489,800
Number of working days during record month..	26	26	26.5
Number of hours in average working day......	16	16	8
Av. number of 2-yd. "mixer-hours" per day	28.4	24	24
Av. quantity of masonry placed per day, cu. yd.	1,309	2,174	3,125
Av. quantity of masonry placed per hour, cu. yd.	81.8	136	354
Av. quantity placed in form of blocks per day, cu. yd.	.....	.....	295
Av. quantity placed in form of pudding stone per day, cu. yd.......	223	40	796
Av. quantity run through mixers per day, cu. yd.	1,086	2,134	2,035
Av. output per "mixer-hour" per month, cu. yd.	46	48	84.8
Best day's run, cu. yd...	1,781	2,430	3,572
Av. output per "mixer-hour" for best day, cu. yd.	62.8	49.7	169.7

All figures in the table are based on the mixed batch capacity of the mixers.

At the Arrowrock dam three 1-yd. mixers are used and the number of 1-yd. mixer hours per day was 48. The average quantity of masonry placed per hour, given as 136 cu. yd., was actually 144 cu. yd. if delays are deducted. The average output per mixer-hour per month, 48 cu. yd., is based upon actual time in operation, with delays deducted.

At Kensico concrete blocks and some cyclopean masonry were placed at night, so that the number of hours in the average working day is not quite correct. Consequently, the figures giving average quantity of masonry placed per hour, quantity placed in the form of pudding stone per day, quantity run through mixers per day and average output per mixer-hour, does not include 7810 cu. yd. placed in night shifts in the form of concrete blocks, 1310 cu. yd. of cyclopean and mass concrete placed in night shifts and 320 cu. yd. of cyclopean masonry placed on a Sunday. The amount of masonry used in obtaining the average per day figures, therefore, was 84,450—1630—7810=75,010 cu. yd.

Structural Members Straightened on Home-Made Table

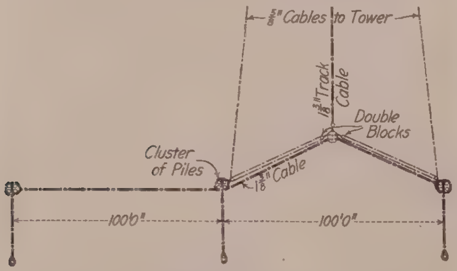
A CONVENIENT structural table used in straightening angle-irons and other members at the new buildings of the Massachusetts Institute of Technology is shown in the accompanying half-tone. It consists essentially of a 12-ton inverted jack clamped to a horizontal 10-in. I-beam carried on 4-in. pipe columns rising from a working plane composed of two 24 x ½-in. plates 7 ft. long, the latter being mounted on legs built of 5 x 3½ x 5/16-in. angles. The horizontal I-beam is clamped at the top to the table by four ⅞-in. bolts terminating at the top in 3½ x 3-in. x 5/16-in. angles and at the bottom in nuts bearing against the under side of the working surface. The latter is strengthened along its lower edge by a 5 x 3 x 5/16-in. angle carried all around the surface on the under side. With this

HOME-MADE TABLE FOR STRAIGHTENING STRUCTURAL MEMBERS

equipment structural members up to 12-in. in depth can be straightened in a small fraction of the time formerly required to mount the piece under treatment and line up the necessary jacks.

Drag-Line Excavator Does Speedy Work in Dredging Channel

IN dredging out a 200-ft. channel of the Wisconsin River at Rothschild, Wis., to a depth of 8 ft. for a distance of 1 mi., 801 cu. yd. of sand and gravel were removed in a 10-hour day by a 2-cu. yd. Shearer & Mayer bucket, which operated on a drag-line cableway having a span of 480 ft. The average daily excavation was 500 cu. yd. The engine and boiler used in operating the bucket were mounted on a movable, self-supporting tower, 60 ft. high. The tail end of the cableway was anchored to a bridle cable, which, in turn, was anchored to clusters of piles, driven 20 ft. into the bed of the river. In order to keep the drag-line cableway at right angles for different positions of the tower while working between two clusters of piles, the cable arrangement shown in the accompanying diagram was adopted. The plant was operated day and night, light being furnished by a local power company. The maximum number of bucket trips totaled fifty-three per hour. For future operation the tower is being mounted on wheels instead of rollers.

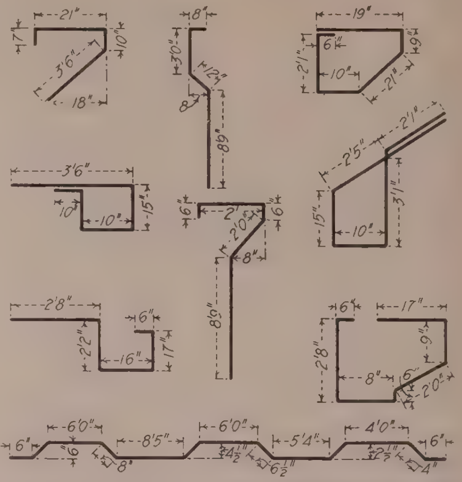


SLIDING ANCHORAGE OF TRACK CABLE

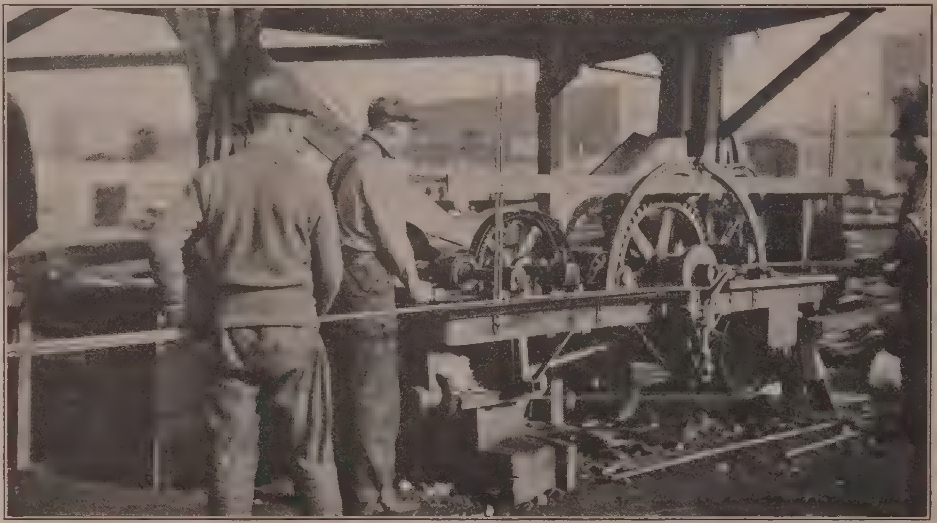
IN 10-HOUR DAY DRAG LINE WITH 480-FOOT CABLEWAY SPAN EXCAVATES 801 CUBIC YARDS

Machine Bends Six Reinforcing Bars at a Time

BENDING slab bars, column binders and putting hooks on straight beam bars quickly and perfectly, right on the job, is the work which the bending machine shown in the accompanying photograph has been doing on a large concrete building construction job in the East. The common type of slab used had eight bends and was made out of ½-in. material. Bending four bars at a time, seven men finished 1323 ½-in. x 40-ft. 6-in. bars of the type mentioned in 5 hr. Bending two bars at a time seven men finished 220 ⅝-in. x 40-ft. 6-in. of the same type in 1 hr. These performances were taken under conditions favorable to speed and during the rush period. Bending six bars at a time, three men turned out 350 ⅜-in. x 8-ft. square column binders in 1 hr. Common labor was used at 25 cents per hour, which made the labor cost of the work about 0.2 cent per lb. A motor was substituted for the gas engine that came with the machine and it was found that it resulted in quicker and more accurate work. The machine is manufactured by Kardong Brothers, of Minneapolis, Minn.



MACHINE-MADE BENDS IN REINFORCING BARS



POWER BENDER WHICH HANDLES SIX REINFORCING RODS AT A TIME

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Snow Plows on Motor Trucks Clear New York Streets

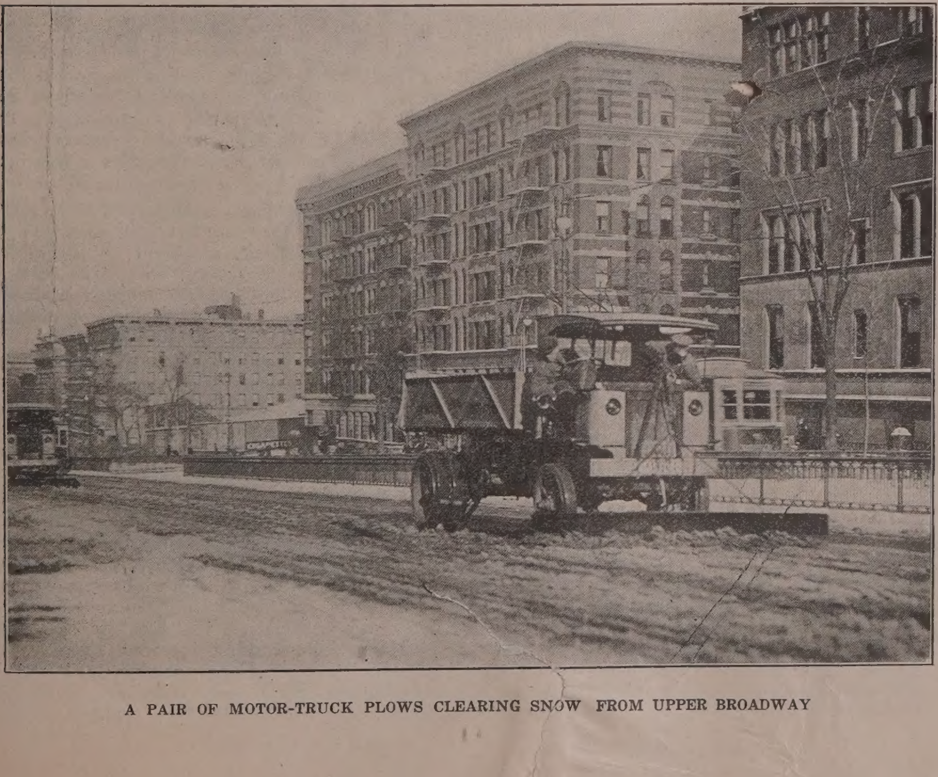
In First Test of Commissioner Fetherston's Snow Removal System Material Is Quickly Piled and Removed to Dumps or Sewers

The first real test of the efficiency of the method of snow removal, involving the use of sewers, as outlined by John T. Fetherston, commissioner of the Department of Street Cleaning, New York City in the Engineering Record of Nov. 28, 1914, page 589, took place last week. The first snow fell on Feb. 2, but the contractors were not called out before Feb. 4, as the weather conditions indicated that a rise in temperature was to be expected. Had this been the case the snow would have been removed without cost to the city. The snowfall on Feb. 4 added 2½ in. to the fall of 1.7 in. Feb. 2 and made it necessary to put in action the extensive snow-removal apparatus.

On the main thoroughfares motor trucks with snow plow attachments were used to pile the snow and clear the streets for traffic. The plows are about 10 ft. wide and placed at such an angle that the strip cleared is approximately 7 ft. in width. On streets where there are car lines the snow was removed from the center and piled along the curbs, while on streets where there are no car lines the snow was taken from the curbs on either side and piled in the center. Two plows were used, one following the other in such a way that the cleared strip was about 13 ft. Twenty-six plows, grouped in pairs were engaged in Manhattan, one in the Bronx and one in Brooklyn. On Fifth Avenue, for instance, where there are no car lines, these plows went up one side of the street from Washington Square Arch to Sixtieth Street, and then turned and went down on the opposite side.

The longitudinal rows of snow were then piled in heaps and removed by the contractors either to the dump on the riverfront or to manholes on the sewers. The illustration shows one pair of trucks in operation.

Approximately $100,000 were spent in removing the snow, and Commissioner Fetherston estimates that a saving of about $200,000 was made over the old methods.



A PAIR OF MOTOR-TRUCK PLOWS CLEARING SNOW FROM UPPER BROADWAY

Railheads Meet on the Canadian Northern Railway

The Canadian Northern Railway is now completed from Lake Superior to the Pacific Coast, the last rail having been laid on Jan. 23 at Basque, a village on the North Thompson river 200 mi. east of Vancouver. It will require until April 15 to ballast the line in shape for trains, it is reported, and the official ceremony of driving the golden spike probably will occur about May 1. It may be midsummer before the railway establishes a regular through service.

Important Cement Company Changes Presidents

Edward M. Hagar Resigns in Order to Acquire Control of Chain of Cement Plants—He Is Succeeded by Benjamin F. Affleck

Edward M. Hagar has resigned as president of the Universal Portland Cement Company, one of the subsidiaries of the United States Steel Corporation, and has been succeeded by Benjamin F. Affleck, until now, general sales manager of the company. Mr. Hagar retires to assume the presidency of a new company, which he is forming to acquire a chain of cement plants covering a large part of the country. Details regarding the new organization have not been announced; the headquarters will be in Chicago.

Retiring President of Large Portland Cement Company and the Man Who Will Succeed Him

EDWARD M. HAGAR

BENJAMIN F. AFFLECK

Mr. Hagar has been the head of the Universal company or its predecessor, the cement department of the Illinois Steel Company, since the first barrel of cement was turned out almost 15 years ago. In the first year, the production was 30,000 barrels, while the capacity now is approximately 12,000,000 per annum. The company has plants in operation at Chicago, Buffington, Ind., and Pittsburgh, while a new mill at Duluth is nearing completion.

Mr. Hagar was graduated from the Massachusetts Institute of Technology in 1893 and received a post-graduate degree from Cornell in 1894. Before becoming connected with the cement industry, he organized and conducted the business of Edward M. Hagar & Company, of Chicago, which acted as sales representative for machinery manufacturers. He was for two years president of the Association of American Portland Cement Manufacturers. He also founded the Cement Products Exhibition Company, which conducts the annual Cement Shows.

Mr. Affleck entered the service of the Illinois Steel Company in 1896 and from 1901 to 1903 represented the cement department of the company in the St. Louis territory. When the Universal Portland Cement Company was incorporated in 1906 to take over the cement business of the steel company he became general sales agent. He is vice-president of the Cement Products Exhibition Company.

Both Mr. Hagar and Mr. Affleck have had a direct hand in the high-grade promotion work done by the Universal company. An extensive information bureau has prepared many technical booklets, all of which are distributed on the basis of their educational value and in none of which, except on the title page, to indicate the source of the information, is the name of the Universal company or of its product mentioned. The theory is that the fundamental purpose of the booklets is to spread reliable information regarding the use of cement, the company relying upon its advertising and sales departments to get its full share of the business stimulated by the educational literature. Editorial comment on their work will be found elsewhere in this issue.

Chicago Fire-Limit Commission Urged by Illinois Architects

The appointment of a commission of twelve citizens to study and report to the Chicago City Council on the advisability of making the fire limits of Chicago coextensive with its boundaries is urged by the Illinois Society of Architects in a set of resolutions sent to Mayor Harrison, the City Council and the committee on buildings. It is recommended that the committee be composed of three members of the council, three architects, three insurance engineers and three real-estate agents. The following phases of the problem are set forth in the resolutions as being necessary of specific investigation:

(a) The comparative annual fire loss in proportion to the insurable value, on frame buildings outside of the existing fire limits, as compared to the annual fire loss to insurable value on similar non-frame buildings within the fire limits. (b) The comparative cost of frame and similar non-frame buildings of same size and similar finish. (c) The actual depreciation rate of frame and similar non-frame buildings, and its effect upon the tax earning and therefore the revenue-producing power of the city. (d) The comparative effect upon real-estate values of frame and similar non-frame buildings. (e) The comparative insurance rate on frame and similar non-frame buildings. (f) The comparative physical and actual obsolescence of frame and similar non-frame buildings. (g) The comparative effect upon the growth of the city of permitting large areas within the city limits to be outside the fire limits of the city.

American Society Endorses Present Alaskan Railway Commission

At its meeting in New York, Jan. 20, the Board of Direction of the American Society of Civil Engineers passed the following resolution, a copy of which has been transmitted to the President of the United States:

"Resolved: That in the opinion of the Board of Direction of the American Society of Civil Engineers, it would be unfortunate for the present Alaskan Railway Commission to be superseded, and that the interest of the public demands that the present commission be allowed to carry out the construction as well as the location of the line."

Though neither the resolution, nor the letter transmitting it to the President, gives any intimation as to the reason for passing it, it was probably prompted by rumors that the construction of the road would be placed in charge of the Corps of Engineers of the army.

Urge Definite Water Power Policy for Massachusetts

The Massachusetts Harbor and Land Commission has submitted a preliminary report to the Legislature recommending that immediate steps be taken to formulate a definite State policy for the control of water power resources. The commission points out the existing lack of consistent jurisdiction arising from the powers residing in the Federal Government, the county commissioners, the State Board of Health and the board itself, and has drafted a bill calling for an appropriation of $25,000 to provide for surveys of ponds and streams, and a survey of areas for possible storage basins under its direction. The report points out that the development of hydroelectric power has rendered early laws bearing upon water-power utilization obsolete and emphasizes the importance of encouraging the investment of capital in the conservation of these resources along with the establishment of a constructive policy of development under the general oversight of the board.

Terminal Market Planned by New York Central

The New York Central Railroad is working in co-operation with the New York State Department of Foods and Markets to provide a market for the receipt and distribution of food supplies in New York City, in connection with a proposed freight terminal on the North River waterfront at Thirty-fourth Street. According to one of the railroad company officials, however, the whole scheme is contingent upon the approval by the city of the West Side improvement from Spuyten Duyvil to St. John's Park.

This terminal, as laid out in a preliminary study, will cover nearly eight blocks from the river front to Tenth Avenue and from Thirty-third Street to Thirty-seventh Street. There will be a ground and elevated level of tracks from the docks through each block to Eleventh Avenue, only the upper tracks running to Tenth Avenue. Along with these freight and warehouse buildings, there will be a market building to be leased by a company comprising both producers and dealers. This building as proposed is to be 200 x 800 ft. in plan, and of sufficient height to provide for cold storage and preservation plants. This is expected to be the first of several city terminal markets throughout the city and State.

John Burke Becomes Treasurer of American Highway Association

United States Treasurer John Burke has accepted the office of treasurer of the American Highway Association, to succeed the late Lee McClung who, from the time of the formation of the association until his death a few weeks ago, was an active worker for the betterment of road conditions and found time from his duties as treasurer of the United States to give the closest attention to road problems.

Mr. Burke will devote particular attention to the subjects of taxation and finance as they enter into the road problem. In a great many sections of the country, Mr. Burke has found little or no attention is paid to the relative merits of serial bonds and the fixed term bonds which are retired by a sinking fund. As a matter of fact it can be mathematically shown that in many cases a serial bond will result in a marked saving to the public.

A New Tunneling Record Made at Rogers' Pass

For the third time in three months the American hard-rock tunneling record has been broken on the Rogers' Pass bore of the Canadian Pacific Railway at Glacier, B. C. During January the contrators, Foley Bros., Welch & Stewart, advanced the west end pioneer heading 932 ft. through slate material. This exceeds by 80 ft. the record made in December and by 115 ft. the record of November. A. C. Dennis is superintendent for the contractors. Joseph Murphy is assistant superintendent on the east end and Joseph Fowler, assistant superintendent on the west end.

Contractors' Materials Wanted in Buenos Aires

That engineers' and contractors' equipment and building materials are much in demand in Argentina is indicated in a letter recently received by the Chicago Association of Commerce from the firm of Boo & Hermano, of Buenos Aires. Portland cement, tools, dynamite, drags, plows, tractors and scales are among some of the articles mentioned.

Concrete-Waterproofing Infringement Decision Sustained

That the use of the water-repellant principle, regardless of the presence or absence of glycerin, in the waterproofing of concrete is an infringement of the Newberry patent of the Medusa Concrete Waterproofing Company has been established by the recent decision of the U. S. Court of Appeals, sustaining the decision rendered Feb. 13, 1914, against the McCormick Waterproofing Portland Cement Company as infringers of the patent.

News of Engineering Societies

The Iowa State Drainage Association will hold its annual meeting Feb. 25 and 26 in Webster City.

The Washington Society of Engineers, at its meeting Feb. 3, heard a lecture on "The World's Greatest Bridges," by Henry S. Jacoby of Cornell University.

The Boston Society of Civil Engineers will hold a regular meeting on Feb. 17, at which an illustrated lecture on Ground Water Supplies will be read by W. S. Johnson.

The Louisiana Engineering Society held its regular meeting at New Orleans, Feb. 8. The annual address of President Williams on the Ethics of the Contractor was discussed by the members.

The Brooklyn Engineers' Club, at its regular meeting on Feb. 11, heard an illustrated lecture by Eric T. King, entitled "Sixty-six Inch Steel Conduits for the Catskill Water Supply in Brooklyn."

The St. Louis Engineers' Club held a regular meeting on Feb. 3, at which Nelson Cunliff, superintendent of construction, Division of Parks, St. Louis, presented a paper on the St. Louis parks and playgrounds.

The Canadian Society of Civil Engineers, at its monthly meeting Feb. 4, heard a paper on Movable Dams, by H. B. Muckleston, and a short address on shell manufacture, illustrated with lantern slides, by H. H. Vaughan.

The Illinois Society of Engineers and Surveyors, at its annual meeting, noted in last week's issue, elected the following officers: President, W. S. Shields; vice-president, Paul Hansen; secretary, E. R. Tratman. The next meeting will be held at Champaign, Ill.

The Toledo Society of Engineers, at its meeting, Feb. 4, heard an illustrated lecture by Elliott H. Whitlock, president of the Cleveland Engineering Society, on a trip through Germany made with other American engineers in 1913, as guests of the Vereiner Deutscher Ingenieure.

The Seattle Association of Members of the American Society of Civil Engineers held its annual meeting and banquet Jan. 25 at the College Club, Seattle. The following officers were elected: President, R. H. Ober; vice-president, A. S. Downey; secretary-treasurer, Carl H. Reeves.

The Colorado Association of members of the American Society of Civil Engineers was addressed Feb. 6 by D. W. Murphy, engineer in charge of drainage, U. S. Reclamation Service, on "The Drainage of Irrigated Lands." Hereafter this association will meet on Saturday evenings, following an informal dinner at 6 p. m. The regular Wednesday weekly luncheons at the Albany Hotel are to be continued.

The Engineers' and Architects' Association of Southern California held its annual meeting Jan. 30 at Los Angeles. The following officers were elected: President, Samuel Sporrow; first vice-president, A. H. Koebig; second vice-president, W. H. Noble; secretary and treasurer, H. Z. Osborne, Jr.; directors, Arthur Bent, J. J. Backus, A. C. Martin and Kenneth Shibley.

The Technology Club of Albany has arranged with the State Department of Education for a series of four free lectures to be delivered on Tuesday evenings, beginning Feb. 9, as follows: The State Highways, by George A. Ricker; The Dams of the State, by Alexander Rice McKim; Public Health, by Theodore Horton, and The State Barge Canal, by Frank M. Williams.

The Engineering Society of George Washington University held its annual banquet Feb. 2, in Washington, D. C. The members were addressed, among others, by Rear Admiral Charles Herbert Stockton, U. S. N., retired, president of the University; F. W. Stratton, director of the Bureau of Standards, and H. L. Hodgkins, dean of the College of Engineering of the University.

The Boston Society of Civil Engineers will hold its sixth annual dinner Feb. 15 at 6 o'clock at the Boston City Club. The American Society of Mechanical Engineers and the American Institute of Electrical Engineers will also participate in the meeting. It is expected that the presidents of all three societies will be present, and the gathering will be addressed by a few speakers of local prominence, including His Excellency, Governor David I. Walsh, on timely topics.

The Washington State County Engineers' Association held its tenth annual convention in conjunction with the Washington County Commissioners' Association at Chehalis, Wash., Jan. 26 to 29. A number of papers, several illustrated with stereopticon slides, of interest to road engineers, were read. The following officers were elected: President, Hans Mumm, Jr.; first vice-president, J. W. Strack; second vice-president, A. P. Denton; secretary and treasurer, A. L. Strong.

The Iowa Engineering Society will hold its twenty-seventh annual meeting at Iowa City, Feb. 17 to 19. Several important committee reports will be heard. The program will include an illustrated paper on the Dayton Flood Relief Project, by F. M. Woodward. Manufacturers' exhibits will be on view of engineering and surveying instruments, clay products, paving brick, tile, water meters, etc. Nelson P. Lewis, chief engineer of the New York Board of Estimate and Apportionment, will read a paper on City Planning.

The Idaho Society of Engineers, at its annual meeting noted last week, elected the following officers for 1915: President, Barry Dibble; first vice-president, William H. Gibson; second vice-president, Frederick A. Wilkie; secretary and treasurer, Ira F. Shaffner. F. W. Callaway, Stuart M. French and G. C. Baldwin were elected members of the executive committee. Irrigation projects, with special reference to bad methods of financing in the past, were discussed, and a committee appointed to investigate the failure of irrigation projects and report proposed remedies.

The American Road Builders' Association held its regular annual meeting at the Hotel Astor on Feb. 5. The following officers for 1915 were elected: President, George W. Tillson; first vice-president, A. W. Dean; second vice-president, Austin B. Fletcher; third vice-president, S. Percy Hooker; secretary, E. L. Powers; treasurer, W. W. Crosby; directors, three-year term, E. A. Fisher, A. R. Hirst, Joseph W. Hunter, Frank F. Rogers, William R. Smith and H. M. Waite. Various reports were heard, including those of the association's committees on standards and legislation, which were adopted and printed for further discussion and action. After the annual dinner at Rector's addresses by several prominent highway officials and engineers were heard.

Personal Notes

Clyde F. Wallow has been appointed city engineer of York, Pa.

G. E. Hauser of Aberdeen, Miss., has been elected engineer for the second State road district.

Edgar H. Adams, formerly with T. H. Fraser Company, of Brooklyn, has opened an office as a general contractor at 278 Madison Avenue, New York City.

Sidney Diamant, consulting engineer, New York City, has been appointed a member of the City Planning Committee of the Citizens Union of which William J. Schieffelin is chairman.

J. H. Seaver has resigned as superintendent of the Great Shoshone and Twin Falls Water Power Company, of Twin Falls, Idaho, and will retire from engineering to take up the business of ranching in Idaho.

Franklin D. Howell has been appointed railroad engineer of the Board of Public Utilities of Los Angeles, Cal., and will have charge of the investigation of the proposed subway system now under consideration in that city.

T. W. Fatherson has been appointed engineer of maintenance-of-way of the Chicago Great Western railroad with headquarters at Des Moines, Iowa. He was formerly assistant engineer of the Rock Island lines at El Reno, Okla., and succeeds C. Millard, resigned.

John B. Hawley, consulting engineer of Fort Worth, Texas, has been elected president of the Texas Association of Members of the American Society of Civil Engineers. Mr. Hawley, who is an alumnus of the University of Minnesota, is also a director of the American Society.

H. G. Sparks has been appointed division engineer at Salem, Ill., of the Chicago and Eastern Illinois railroad, succeeding J. W. Hunter, who has been transferred to Danville, Ill., as division engineer in place of W. A. Van Frank, resigned. Mr. Sparks was formerly division engineer at Evansville, Ind., and is succeeded in that position by C. Brannon, assistant division engineer at Chicago.

Col. Harry F. Hodges, Corps of Engineers, U. S. A., former vice-governor of the Canal Zone, was recently detailed as engineer officer in charge of the Washington river and harbor district, and of the Washington aqueduct. Colonel Hodges will complete the special detail work on which he is now engaged for the War Department before taking up his new duties. He will succeed Col. Henry C. Newcomer, who will return to his old duties as a member of the River and Harbor board.

Obituary Notes

Felix Barbeau, a railway contractor of Minneaoplis, died Jan. 31 in that city at the age of 64 years.

A. G. Hathaway, head of the firm of A. G. Hathaway & Company, building contractors, of Cleveland, Ohio, died Jan. 25, in that city.

Elie M. Grenier died Feb. 3 at St. Paul, Minn. He was the son of Achille N. Grenier, the French engineer and author, and was himself a civil engineer.

Charles W. Campbell, city engineer of St. Joseph, Mo., died Jan. 6, in that city. Mr. Campbell, who was an alumnus of Rensselear Polytechnic Institute, had been engaged in the practice of his profession in St. Joseph for more than thirty years. Among other work, he was in charge of the construction of the reservoirs of the St. Joseph Water Company, and in charge of laying out the railway yards of the Missouri Pacific Railroad at St. Joseph.

William Edwin Moore, member of the firm of Ingersoll, Bugbee & Moore of Spokane, Wash., who for many years directed the affairs of the Lewiston-Clarkston Power & Irrigation Campbell, who was an alumnus of Rensselaer Mr. Moore went to Lewiston, Idaho, 29 years ago to build the Lewiston-Clarkston bridge, and since that time has remained in the Northwest and engaged in many engineering enterprises. He planned and constructed the upper power house on Asotin creek, the pipe line system that now conveys the water from Asotin creek to the Clarkston district, and the first steam plant erected in Clarkston. He was identified with the Hayden Lake project and a number of mining developments in the Cœur d'Alene region of Idaho. Mr. Moore was a graduate of the Massachusetts Institute of Technology, a member of the American Society of Engineers, and of the International Society of Hydraulic Engineers.

Civil Service Examinations

Illinois State.—The following examinations will be held March 6, and application for them must be on file in Springfield by Feb. 27:

Junior highway engineer, $75 to $100 a month with expenses. Open to non-residents. Applicants must be 21 years of age.

Assistant highway engineer, salary $105 to $150 a month and traveling expenses. Promotional examination open to men over 25 years old now in the service.

Draftsman, salary $75 to $100 a month. Candidates must be over 20 years of age.

In addition to these examinations, the following positions with the Illinois Public Utilities Commission are vacant, and will be filled by examinations soon to be announced: Assistant chief utilities engineer, $300 to $375 a month; gas engineer, $250 to $333.33 a month; railroad engineer, $250 to $333.33 per month; service engineer, $200 to $300 per month; assistant railroad engineer, $160 to $200 per month; assistant utilities engineer, $90 to $125 a month, and utilities investigator, $100 to $150 per month.

For full information address the Illinois State Civil Service Commission at Springfield, Ill.

New York State.—Examinations will be held Feb. 27 throughout the State for the following positions, for which applications should be filed by Feb. 19:

Junior assistant, engineering department, $901 to $1200. Minimum age, 20 years.

Chainman, $2.50 to $3 a day. Minimum age, 18 years.

Inspector of construction, county service, Greene County, $3.50 to $4.50 per day. Applicants must have had experience on roads or other public work.

Examinations Previously Announced

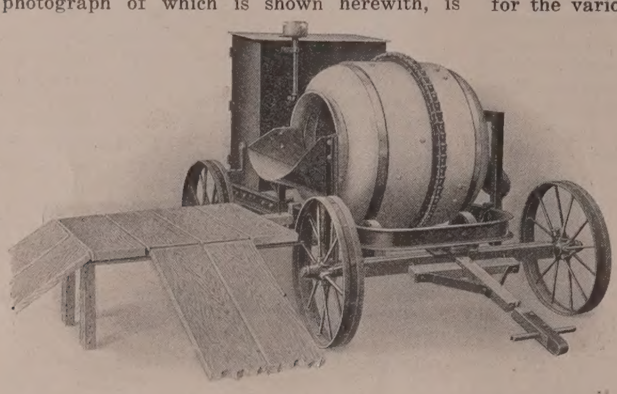
Date		See Eng. Record
Feb. 23-27	Assistant engineer and draftsman, City of Philadelphia	Jan. 30
Feb. 24-25	Hull draftsman, United States	Jan. 30
Feb. 19-20	Civil engineer, California State	Feb. 6
Feb. 26-27	Engineering draftsman, California State	Feb. 6
March 10	Aid, Coast and Geodetic Survey; computer, Coast and Geodetic Survey; copyist topographic draftsman, departmental service; junior engineer draftsman; topographic draftsman; surveyor, Philippine service; superintendent of construction, supervising architect's office, United States	Feb. 6
April 14	Civil engineer and draftsman; copyist draftsman, Navy Department; mechanical draftsman, Panama Canal Service; shipdraftsman, Navy Department; topographic draftsman, Panama Canal Service; engineer, Indian Service; United States	Feb. 6
March 2	Designing engineer, United States	Feb. 6

Gasoline-Operated Locomotive Crane

A small locomotive crane handling a grab bucket and operated by a gasoline engine has recently been put on the market. This crane is intended for light or intermittent work, such as handling coal, or for use in a contractor's storage yard where service is not continuous. The motive power used makes the crane always available for immediate use, and obviates waste of fuel when the crane is not in service. The Industrial Works of Bay City, Mich., are the manufacturers of this machine.

Low Charging Platform for Small Batch Mixer

A 5-cu. ft. batch mixer arranged so that it can be charged by dumping wheel barrows directly into the rear of the drum has been put on the market by the Chain Belt Company, of Milwaukee. This arrangement does away with the use of an elevator, and at the same time requires only a very short wheel barrow incline. The drum of this mixer, a photograph of which is shown herewith, is made in halves of cast semi-steel. The mixer known as the "Rex," is operated by a 3-hp gasoline engine, which is equipped with a friction clutch and the chain belt drive.



LOW PLATFORM SIMPLIFIES CHARGING OF MIXER

Electric Dredge Cuts New Channel Through Hills for Cuyahoga River

An electrically operated suction dredge is being used to cut across a bend of the Cuyahoga River, near Cleveland. This work will straighten the river channel, and at the same time reclaim about 350 acres of land cut up by the present course of the river. The excavated material is being used to fill in around the new plant of the Otis Steel Company at Brooklyn, Ohio. The new channel cuts through a hill 200 ft. high, but steam-shovels had removed a good part of this hill before the dredge reached it.

The dredge, designed by the Marion Steam Shovel Company for this work, which is being done by P. T. McCourt, of Akron, Ohio, is of steel frame construction. The switchboard, gages, and all controlling apparatus are located in the pilot house, so that one man controls the operation of the dredge. The hull is 80 x 25 ft., and 5 ft. deep, built of steel throughout. All the machinery of the dredge is electrically operated. Three-phase, sixty-cycle, current at 2200 volts is supplied through a flexible underwater cable from a transmission line which parallels the cut. A small transformer supplies current for lighting.

The main dredging pump has 16-in. suction and discharge, and is direct-connected to a 300-hp motor provided with the controlling apparatus for running continuously with a 25 per cent speed reduction. It is designed to deliver 225 cu. yd. per hour. A 6-in. 3-stage Worthington turbine pump direct connected to a 200-hp motor supplies water at a head of 360 ft. to the monitor nozzle mounted on the front of the boat, which is used for sluicing material to the dredge. A 3-in. Worthington pump direct connected to a 15-hp motor supplies water for priming and general use, and for the various water-sealed stuffing boxes on the pumps and suction pipes. A 5-drum hoist geared to a 20-hp motor handles the suction head, and raises the spuds. The cutter head is driven through reducing gearing by a 75-hp motor. The motors operating the hoist and the cutter head can be run at a 50 per cent speed reduction.

The dredge was put in operation on June 25, 1914, and although some time was lost, due to the necessity of changing cutter heads, and to the fact that many large logs were encountered in the path of the channel, it is expected that the work will be completed this year. The channel excavated is 8 ft. deep and 150 ft. wide, and will be deepened later on to permit navigation.

Business Notes

The Hugo Burgheim Company, of Cincinnati, has removed its office to the Mercantile Library Building.

The National Lime Manufacturers' Association held its annual meeting Feb. 3 and 4 at Washington, D. C.

The New England Foundation Company, Inc., has removed its offices from 73 Tremont Street to 70 Kilby Street, Boston, Mass.

The Ball Engine Company, of Erie, Pa., is now engaged in the manufacture of steam shovels. Arthur C. Vicary will be sales manager of the new department.

Laughlin F. McNeill, building contractor, has opened offices at 1713-17 Sansom Street, Philadelphia.

The American Manufacturing Company, of Chattanooga, Tenn., has equipped a factory at that city for the manufacture of shovels.

The Blaw Steel Construction Company announces the election as its president of Albert C. Lehman, formerly vice-president and general manager of the company.

The Charles McDermott Company has been incorporated to continue the contracting business formerly conducted at Philadelphia by the estate of Charles McDermott.

The Terry Steam Turbine Company has opened an office in Atlanta, Ga., in charge of Earle F. Scott, 702 Candler Building. The Pittsburgh office of this company, in charge of H. A. Rapelye, is now located at 1624 Oliver Building.

The George W. Jackson Construction Company, of Chicago, has recently been organized under the laws of Illinois with a paid up capital of $500,000 to undertake the construction of heavy foundations and general underground and overhead construction.

C. R. Dodge & Company is the name of a firm recently formed by C. R. Dodge and G. H. Edbrooke, formerly of Dodge & Dodge, to handle contractors' machinery. The offices of the firm are located at 33 West Forty-second Street, New York City.

The Ayer & Lord Tie Company announces that after Feb. 15 their Cleveland office will be in charge of B. S. McConnell, who replaces F. A. Weaver, resigned. Mr. McConnell was formerly in charge of the Chicago territory, where he will be succeeded by R. W. Slaney.

The Cement Gun Company, with offices at 30 Church Street, New York City, has acquired the United States rights of the General Cement Gun Company, of Chicago. This company has opened a Chicago office at 914 South Michigan Avenue, in charge of Charles A. Cooper.

French & Allen, Chicago representative of the Lakewood Line and Minneapolis hoisting engines, have moved their offices to 506 South Canal Street, where they have a permanent exhibit. William Ord, formerly with Marsh-Capron Company, is now connected with French & Allen.

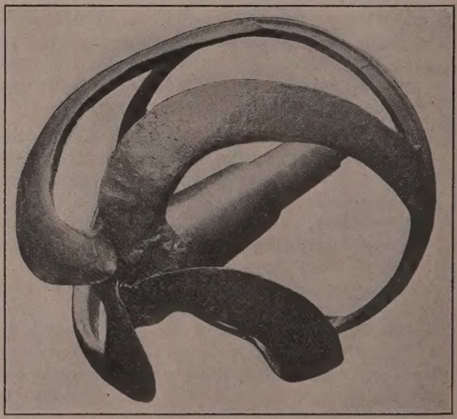
Trade Publications

The following companies have recently issued trade publications:

The Hudson Machinery Company; Folder, 5 x 9 in., illustrated; describes the Hudson duplex wagon loader, an improved loader operated by a 2-hp. motor, either gasoline or electric.

The Atlas Car & Manufacturing Company of Cleveland, Ohio; Bulletin No. 1175, 5 x 9 in., 32 pages, illustrated; describes a large line of locomotives, cranes and cars for mining and contractor's use, operated by storage batteries.

THIS SUCTION DREDGE IS CUTTING A NEW CHANNEL FOR CUYAHOGA RIVER



NEW CUTTER HEAD

Cutter head shown in view of dredge was unsatisfactory in clay and was changed for that illustrated at right.